CITY OF BRAZIL, INDIANA

DRAINAGE AND SEDIMENT CONTROL

ORDINANCE

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ORDINANCE NO. 01-2000

AN ORDINANCE REGULATING DRAINAGE AND SEDIMENT CONTROL STANDARDS

Be it ordained by the City of Brazil that:

The City Code is amended by this document as follows:

ARTICLE 1, DRAINAGE AND SEDIMENT CONTROL STANDARDS.

Sec. 1-10 Preamble.

The purpose of this Article is to reduce the hazard to public health and safety caused by excessive stormwater runoff, to enhance economic objectives, and to protect, conserve and promote the orderly development of land and water resources within the City of Brazil.

This ordinance regulates:

(a.) Stormwater drainage improvements related to development of lands located within the City of Brazil, including Minor and Major Subdivisions.

(b.) Drainage control systems installed during new construction and grading of lots and other parcels of land.

(c.) Erosion and sediment control systems installed during new construction and grading of lots and other parcels of land.

(d.) The design, construction, and maintenance of stormwater drainage facilities and systems.

Sec. 1-11 Conflicting Ordinances.

The provisions of this ordinance shall be deemed as additional requirements to minimum standards required by other ordinances of Clay County. In case of conflicting requirements, the most restrictive shall apply.

Sec. 1-12 Compliance with This and Other Ordinances.

In addition to the requirements of this ordinance, compliance with the requirements set forth in the Zoning Ordinance of the City of Brazil, Subdivision Ordinance of the City of Brazil and other applicable ordinances with respect to submission and approval of preliminary and final Subdivision Plats, improvement plans, building and zoning permits, construction, inspections, appeals and similar matters, and compliance with applicable State of Indiana statues and regulations shall be required. *No Drainage Permit* shall be issued for development within the City limits as defined in Section 1-13 (b) except single-family dwelling houses in approved subdivisions, until the plans for such construction, extension, remodeling, alteration or repair have been approved in writing by the **City of Brazil** and the **Engineer**. This process for obtaining a Drainage Permit is outlined in Section 1-17.

Sec. 1-13 Abbreviations and Definitions.

For the purpose of this ordinance, the following abbreviations and definitions shall apply. Although not all of the abbreviations and definitions listed below are used in this ordinance, the additional terminology is provided to assist ordinance administrators, other community officials, residents and permit applicants in understanding technical terminology associated with the subject matter of this ordinance.

(a.) Following are abbreviations which are referred to throughout this Ordinance:

AC-FT	Acre-Feet
CFS	Cubic Feet per Second
COE	United States Army Corps of Engineers
FEMA	Federal Emergency Management Agency
FPS	Feet per Second
HERPICC	Highway Extension and Research Project for Indiana Counties and Cities
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
INDOT	Indiana Department of Transportation
NRCS	National Resources Conservation Service

SWCD Soil and Water Conservation District

(b.) Following are definitions of terms that are relevant to this Ordinance:

Apparent Right-of-Way. All that area lying adjacent to, and including, the public road which is being used and occupied by the public and public utilities, and the area of maintenance by county or city government. The limits of the apparent right-of-way shall be defined as the greater of any of the following:

1. Existing fence of long standing.
2. Edge of existing utilities.
3. Field occupation lines (plowed or tilled ground).
4. Existing woody vegetation (may signify evidence of prior fence location).
5. Or if none of the above exists, edge of traveled road surface, and the adjacent area of maintenance by a county or city road department.

The apparent right-of-way is subordinate to dedicated right-of-ways of record.

Backflow Preventer. A device that allows liquids to flow in only one direction in a pipe. Backflow preventers are used on sewer pipes to prevent a reverse flow during flooding situations.

Backwater. The rise in water surface elevation caused by some obstruction such as a narrow bridge opening, buildings or fill material that limits the area through which the water shall flow.

Base Flood. See "Regulatory Flood".

Base Flood Elevation (BFE). The water surface elevation corresponding to a flood having a one percent probability of being equaled or exceeded in a given year.

Basement. Any area of the building having its floor subgrade on all sides.

Benchmark. A marked point of known elevation from which other elevations may be established.

Best Management Practices. Design, construction, and maintenance practices and criteria for stormwater facilities that minimize the impact of stormwater runoff rates and volumes, prevent erosion, and capture pollutants.

Building. See "Structure".

Capacity of a Storm Drainage Facility. The maximum flow that can be conveyed or stored by a storm drainage facility without causing damage to public or private property.

Centerline of Channel. The middle point or baseline of a channel.

Channel. A natural or artificial watercourse which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a defined bed and banks which serve to confine the water.

Contiguous. Adjoining or in actual contact with.

Contour. Imaginary line on the earth's surface which connects points of equal elevation.

Contour Line. Line on a map which represents a contour or points of equal elevation.

Control Structure. A structure designed to control the rate of flow that passes through the structure, given a specific upstream and downstream water surface elevation.

Cross Walkway. A strip of land dedicated to public use, which is reserved across a block to provide pedestrian access to adjacent areas.

Crown of Pipe. The elevation of the top or highest point of the internal surface of the transverse cross section of a pipe.

Cross-Section. A graph or plot of ground elevation across a stream valley, or a portion of it, usually along a line perpendicular to the stream or direction of flow.

Cubic Feet Per Second (CFS). Used to describe the amount of flow passing a given point in a stream channel. One cubic foot per second is equivalent to approximately 7.5 gallons per second.

Culvert. A closed conduit used for the conveyance of surface drainage water under a roadway, railroad, canal or other impediment.

Curve Number (CN). The NRCS index that represents the combined hydrologic effect of soil, land use, land cover, hydrologic condition and antecedent runoff condition.

Dam. All obstructions, wall embankments or barriers, together with any abutments and appurtenant works, constructed too store, direct water or create a pool (not including underground water storage tanks).

Datum. Any level surface to which elevations are referred, usually using Mean Sea Level.

Depressional Storage Areas. Non-riverain depressions in the earth where stormwater collects. The volumes are often referred to in units of acre-feet.

Design Storm. A selected storm event, described in terms of the probability of occurring once within a given number of years, for which stormwater or flood control improvements are designed and built.

Detention Facility. A facility designed to detain a specified amount of stormwater runoff assuming a specified release rate. The volumes are often referred to in units of acre-feet. Examples include on rooftops, in streets, parking lots, school yards, parks, open spaces or other areas under predetermined and controlled conditions.

Detention Storage. The temporary storage of stormwater in a detention facility, with the rate of release regulated by appropriately installed devices.

Development. Any man-made change to improved or unimproved real estate a quarter-acre or larger including but not limited to:

1. Construction, reconstruction, or placement of a building or any addition to an existing building that adds over 1/4 acre or more of impermeable surface (ie: rooftop, parking lot, driveway, etc.);

2. All subdivisions requiring approval under the current City of Brazil Subdivision Ordinance, effective after the adoption of this Drainage Ordinance;

3. Installing utilities, construction or reconstruction of roads, or similar projects;

4. Construction of flood control structures such as levees, dikes, dams, channel improvements, etc.;

5. Mining, dredging, filling, grading, excavation;

6. Construction and/or reconstruction of bridges or culverts;

7. Any other activity that might change the direction, height, or velocity of flood or surface waters.

"Development" does not include activities such as the maintenance of existing buildings and facilities such as painting or re-roofing; resurfacing roads, or gardening, plowing, and similar agricultural practices. In addition, "Development" does not include the reconstruction or maintenance of regulated drains or replacement of existing stream crossings by the City of Brazil.

Discharge. Normally, the rate of flow into or out of a sewer, stormwater storage facility, or from a land surface. Discharges are customarily measured in cubic feet per second (cfs).

Drainage Area. The area from which water is carried off by a drainage system; a watershed or catchment area.

Drainage Easement. An authorized grant made by a property owner for use by another of any designated part of his property, and legally recorded, for the purpose of ensuring satisfactory present and future drainage of the property and the area surrounding the property.

Drop Manhole. Manhole having a vertical drop pipe connecting the inlet pipe to the outlet pipe. The vertical drop pipe shall be located immediately outside the manhole.

Dry-Bottom Detention Facility. A facility designed to be completely dewatered after having provided its planned detention or runoff during a storm event.

Duration. The time period of a rainfall event.

Easement. A grant by a property owner for the use of a strip of land by the general public, a corporation, or a certain person or persons for a specific purpose or purposes.

Engineer. See "Professional Engineer".

Erosion. Wearing away of the land by running water and waves, abrasion, temperature changes, ice and wind.

Extraterritorial Jurisdiction. Any area(s) outside of civil boundaries where a specified governmental body has the right to interpret and apply the law.

Farm or Field Tile. A subsurface pipe installed in an agricultural area to allow drainage of farmland.

Flood or Flood Waters. A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow, the unusual and rapid accumulation, or the runoff of surface waters from any source.

Flood Boundary and Floodway Map (FBFM). A map prepared by Federal Emergency Management Agency (FEMA) that depicts the FEMA designated floodways within a community. This map also includes the delineation of the 100-year and 500-year floodplain boundaries and the location of the Flood Insurance Study cross-sections.

Flood Crest. The maximum stage or elevation reached or expected to be reached by the waters of a specified flood at a given location.

Flood Duration. The length of time a stream is above flood stage or overflowing its banks.

Flood Easement. Easement granted to identify areas inundated by the 100-year flood.

Flood Elevation. The elevation at all locations delineating the maximum level of high waters for a flood of given return period.

Flood Frequency. A statistical expression of the average time period between floods equaling or exceeding a given magnitude. For example, a 100-year flood has a magnitude expected to be equaled or exceeded on the average once every hundred years; such a flood has a one-percent chance of being equaled or exceeded in any given year. Often used interchangeably with "recurrence interval".

Flood Insurance Rate Map (FIRM). A map prepared by FEMA that depicts Special Flood Hazard Areas within a community. This map also includes the 100-year or Base Flood Elevation at various locations along the watercourses. More recent versions of the FIRM may also show the FEMA designated floodway boundaries and the location on the Flood Insurance Study cross-sections.

Flood Insurance Study (FIS). A study prepared by FEMA to assist a community participating in the National Flood Insurance Program in its application of the program regulations. The study consists of a text which contains community background information with respect to flooding, a floodway data table, summary of flood discharges, flood profiles, a Flood Insurance Rate Map, and a Flood Boundary and Floodway Map.

Flood Hazard Boundary Map (FHBM). A map prepared by the FEMA that depicts Special Flood Hazard Areas as a Zone A within a community. There are no study texts, base flood elevations or floodways associated with this map.

Floodplain. The channel proper and the areas adjoining the channel which have been or hereafter may be covered by the regulatory or 100-year flood. Any normally dry land areas that is suspectable to being inundated by water from any natural source. The floodplain includes both the floodway and the floodway fringe districts.

Floodplain Management. The operation of a program of corrective and preventive measures for reducing flood damage, including but not limited to flood control projects, floodplain land use regulations, floodproofing of buildings, and emergency preparedness plans.

Floodplain Regulations. General term applied to the full range of codes, ordinances and other regulations relating to the use of land and construction within floodplain limits. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, encroachment laws and open area (space) regulations.

Flood Profile. A graph showing the relationship of water surface elevation to a specific location, the latter generally expressed as distance above the mouth of the stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific magnitude of flooding, but may be prepared for conditions at any given time or stage.

Flood Protection Grade (FPG). The elevation of the regulatory or 100-year flood plus two (2) feet at any given location in the Special Flood Hazard Area or 100-year floodplain.

Floodway. The channel of a river or stream and those portions of the floodplains adjoining the channel which are reasonably required to efficiently carry and discharge the peak flow of the regulatory flood of any river or stream.

Floodway Fringe. That portion of the floodplain lying outside the floodway, which is inundated by the regulatory flood.

Footing Drain. A drain pipe installed around the exterior of a basement wall foundation to relieve water pressure caused by high groundwater elevation.

Freeboard. An increment of height added to the base flood elevation to provide a factor of safety for uncertainties in calculations, unknown local conditions, wave actions and unpredictable efforts such as those caused by ice or debris jams. (See Flood Protection Grade).

French Drain. A drainage trench backfilled with a coarse, water-transmitting material; may contain a perforated pipe.

Gabion. An erosion control structure usually consisting of wire cage filled with rocks.

Grade. The inclination or slope of a channel, canal, conduit, etc. or natural ground surface usually expressed in terms of the percentage the vertical rise (or fall) bears to the corresponding horizontal distance.

Hydraulic Grade Line (HGL). The open channel flow, the HGL is equal to the water surface elevation, whereas for pressure flow it is the level to which water will rise in a pipe due to its own pressure.

Hydrodynamic Loads. Forces imposed on structures by floodwaters due to the impact of moving water on the upstream side of the structures, drag along its sides, and eddies or negative pressure on its downstream side.

Hydrograph. For a given point on a stream, drainage basin, or a lake, a graph showing either the discharge, stage (depth), velocity, or volume of water with respect to time.

Hydrology. The science of the behavior of water, its dynamics, composition and distribution in the atmosphere, on the surface of the earth, and underground. A typical hydrologic study is undertaken to compute flowrates associated with specified flood events.

Impervious Surface. Any hard-surfaced, man-made area that does not readily absorb or retain water, including but not limited to building roofs, parking and driveway areas, compacted graveled areas, sidewalks and paved recreation areas.

Infiltration. Passage or movement of water into the soil.

Infiltration Swales. A depressed earthen area that is designed to promote infiltration.

Inlet. An opening into a storm sewer system for the entrance of surface stormwater runoff, more completely described as a storm sewer inlet.

Invert Elevation. The elevation at the inside bottom of a culvert or other conduit.

Junction Chamber. A converging section of conduit, usually large enough for a person to enter, used to facilitate the flow from one or more conduits into a main conduit.

Land Surveyor. A person licensed under the laws of the State of Indiana to practice land surveying.

Lateral Storm Sewer. A storm sewer that has an inlet at its upstream end and empties into another storm sewer or facility.

Letter of Map Amendment (LOMA). A letter from FEMA removing an existing structure or a legally defined parcel of land unaltered by fill from a Special Flood Hazard Area.

Letter of Map Revision (LOMR). A letter from FEMA officially revising the current National Flood Insurance Program map to show changes to floodplains, floodways, or flood elevations. LOMR's typically depict decreased flood hazards.

Low Entry Elevation. The elevation in a structure where overbank flooding can enter the structure.

Lowest Adjacent Grade. The absolute lowest grade around the outside of a structure, taking into account patios and support posts for decks or porches.

Lowest Floor. Refers to the lowest of the following:

1. The top of the basement floor;

2. The top of the garage floor, if the garage is the lowest level of the building;

3. The top of the first floor of buildings construction on a slab or of buildings elevated on pilings or construction on a crawl space with permanent openings; or

4. The top of the floor level of any enclosure below an elevated building where the walls of the enclosure provide any resistance to the flow or flood waters unless:

    a] The walls are designed to automatically equalize the hydrostatic flood forces on the walls by allowing for the entry and exit of flood waters, by providing a minimum of two openings (in addition to doorways and windows) having a total area of one (1) square foot for every two (2) square feet of enclosed area subject to flooding. The bottom of all such openings shall be no higher than one (1) foot above grade.

    b] Such enclosed space shall be usable only for the parking of vehicles or building access.

Major Drainage System. Drainage system carrying runoff from drainage area of one (1) or more square miles.

Manhole. Storm sewer structure through which a person may enter to gain access to an underground storm sewer or enclosed structure.

Manning Roughness Coefficient or Manning's "n" Value. A dimension less coefficient ("n") used in the Manning's equation to account for channel wall frictional losses in steady uniform flow.

Minor Drainage System. Drainage system carrying runoff from a drainage area less than one (1) square mile.

National Flood Insurance Program (NFIP). The NFIP is a Federal program enabling property owners to purchase flood insurance. FEMA administers the NFIP in communities throughout the United States. The NFIP is based on an agreement between local communities and the Federal government which states that if a community will implement floodplain management measures to reduce future flood risks to new construction and substantially improved structures in flood hazard areas, the Federal government will make flood insurance available within the community as a financial protection against flood losses that do occur.

National Geodetic Vertical Datum of 1929 (NGVD 1929). A nationwide Federal Elevation datum used to reference topographic elevations to a known value.

Off-Site. Everything not located at or within a particular site.

On-Site. Located within the developing property where runoff originates.

100-Year Frequency Flood. The flood having a one percent (1%) probability of being equaled or exceeded in any given year.

Open Channel. A conveyance in which the liquid stream is not completely enclosed by solid boundaries.

Orifice. A device which controls the rate of flow from a detention basin.

Outfall. The point or location where storm runoff discharges from a sewer or drain. Also applies to the outfall sewer or channel which carries the storm runoff to the point of outfall.

Overland Flow. Consists of sheet flow, shallow concentrated flow and open channel flow.

Peak Flow. The maximum rate of flow of water at a given point in a channel or conduit resulting from a predetermined storm or flood.

Planimetric Data. Horizontal measurements involving distances or dimensions on a diagram, map, Plat of Survey, or topographic map. Normally given in units of feet or meters.

Plat of Survey. A scaled diagram showing boundaries of a tract of land or subdivision. This may constitute a legal description of the land and be used in lieu of a written description.

Private Drive. A private drive serves as the means of vehicular access to the public road or street system for not more than one residence or business.

Professional Engineer. A person licensed under the laws of the State of Indiana to practice professional engineering.

Rainfall Intensity. The cumulative depth of rainfall occurring over a given duration, normally expressed in inches per hour. In the Rational Formula, this represents the average rainfall intensity over a duration equal to the time of concentration for the catchment.

Reach. Any length of stream, channel or storm sewer.

Recurrence Interval. A statistical expression of the average time between floods equaling or exceeding a given magnitude.

Redevelopment. See the definition for "Development".

Regulated Area. All of the City of Brazil under the control of the Brazil City Council.

Regulated Drain. A drain, either open channel or closed tile/sewer, subject to the provisions of the Indiana Drainage Code, I.C.-36-9-27.

Regulatory Flood. The discharge or elevation associated with the 100-year flood as calculated by a method and procedure which is acceptable to and approved by the IDNR and FEMA. The "regulatory flood" is also known as the "base flood".

Release Rate. The amount of stormwater released from a stormwater control facility per unit of time.

Reservoir. A natural or artificially created pond, lake or other space used for storage, regulation or control of water. The reservoir may be either permanent or temporary. The term is also used in the hydrologic modeling of storage facilities.

Retention Facility. A facility designed to completely retain a specified amount of stormwater runoff *without* release except by means of evaporation, infiltration or pumping. Volumes are often referred to in units of acre-feet.

Return Period. The average interval of time within which a given rainfall event will be equaled or exceeded once. A flood having a return period of 100 years has a one percent (1%) probability of being equaled or exceeded in any one year.

Right-of-Way. A strip of land appropriated for public use as a street, highway, driveway, alley or walkway or for any drainage or public utility purpose or other similar uses.

Right-of-Way for a County Drain. Land through which a regulated county drain passes as defined by a drainage easement, and/or Section 33 of the Drainage Code IC-36-9-27 (as amended).

Riprap. Large rock that when installed along an erodible surface reduces the erosion and scour potential.

Riverine. Relating to, formed by, or resembling a stream (including creeks and rivers).

Runoff. The waters derived from melting snow or rain falling within a tributary drainage basin that exceed the infiltration capacity of the soils of that basin, flow over the surface of the ground, or are collected in channels or conduits.

Runoff Coefficient. A decimal fraction relating the amount of rain which appears as runoff and reaches the storm sewer system to the total amount of rain falling. A coefficient of 0.5 implies that 50 percent (50%) of the rain falling on a given surface appears as stormwater runoff.

Sanitary Backup. The condition where a sanitary sewer reaches capacity and surcharges into the lowest available area.

Scour. The clearing and digging action of flowing water.

Sediment. Material of soil and rock origin, transported, carried or deposited by water.

Sedimentation. The process that deposits soil, debris and other materials either on the ground surfaces or in bodies of water or watercourses.

Seepage. The passage of water or other fluid through a porous medium, such as the passage of water through an earth embankment or masonry wall.

Silt Screen Fence. A fence constructed of wood or steel supports and either natural (e.g.

burlap) or synthetic fabric stretched across area of flow during site development to trap and retain on-site sediment due to rainfall runoff.

Siphon. A closed conduit or portion of which lies above the hydraulic grade line, resulting in a pressure less than atmospheric and requiring a vacuum within the conduit to start flow. A siphon utilizes atmospheric pressure to effect or increase the flow of water though a conduit. An inverted siphon is used to carry stormwater flow under an obstruction such as a sanitary sewer.

Special Flood Hazard Area (SFHA). Those lands within the jurisdiction of a community which are subject to inundation by the regulatory or 100-year flood. Special Flood Hazard Areas are usually designated on a Flood Hazard Boundary Map as Zone A. After detailed evaluation of local flooding characteristics, the Flood Insurance Rate Map will refine this categorization into Zones A, AE, AH, AO and AI-30.

Spillway. A waterway in or about a hydraulic structure designed for the escape of excess water.

Storm Duration. The length of time that water may be stored in any stormwater control facility, computed from the time water first begins to be stored. Storm Duration may also refer to the length of a qualified rainfall event (0.5 hour, 1-hour, or 24-hour storms, for example).

Storm Sewer. A closed conduit for conveying collected stormwaters.

Stormwater Facility. All ditches, channels, conduits, levees, ponds, natural or manmade impoundments, wetlands, tiles, swales, sewers, and other natural or artificial means of draining surface and subsurface water from land.

Stormwater Runoff. The water derived from rains falling within a tributary basin, flowing over the surface of the ground or collected in channels or conduits.

Street. The space or area between the lot lines, abutting upon a right-of-way and designed as a way for vehicular traffic whether designated as an alley, street, highway, throughway, freeway, expressway, road, avenue, boulevard, lane, place, or however otherwise designated and which shall include but not be limited to those illustrated in the Comprehensive Plan for the City of Brazil. For the purpose of this Article, street shall be classified as follows:

1. <u>Freeways</u> are limited-access highways which carry large volumes of interstate traffic and have more importance regionally than locally. They often contain four (4) or more moving lanes and permit a continuous high speed traffic flow. These highways have a high order of design and construction requirements.

2. <u>Arterials</u> are those Federal, State and County roads of regional importance. These are high capacity highways moving traffic at fast rates of speed. They provide good continuity between distant points and are constructed to high standards. Arterial Highways provide two (2) to four (4) traffic lanes and should have a median strip wherever possible. Crossing traffic from other roads and access to abutting properties are often controlled, or partially so.

3. <u>Major Collector</u> highways have less regional importance than the Arterial highways and more county or inter-county significance. They are medium capacity highways moving traffic at relatively fast rates of speed. They include both State designated routes and county roads. Major collector highways provide two (2) traffic lanes.

4. <u>Minor Collector</u> roads are moderate capacity thoroughfares designed to accommodate relatively low speed traffic. They should, however, provide a smooth flow of traffic. Two (2) moving lanes, unseparated, but wider than local road lanes are required.

5. <u>Local Roads</u> are low capacity and low speed roads whose function is to provide direct access to homes and property. Through-traffic and heavy use of these roads should be discouraged. To the extent possible, residence driveways and ingress and egress points to other uses or structures should be oriented to the Local Roads rather than to the Arterials or Collectors.

6. <u>Marginal Access Streets</u> are local roads which are parallel to and adjacent to arterial streets and highways, and which provide access to abutting properties and protection from through-traffic.

7. <u>Local Subdivision Streets</u> are low capacity and low speed streets within major subdivisions whose function is to provide direct access to homes and property. Through-traffic and heavy use of these streets should be discouraged.

8. <u>Cul-De-Sac</u> street is a local road with only one outlet, having a paved, circular, turn-around at the closed end.

9. <u>Alley</u> is a minor way which is used primarily for vehicular service access to the back or side of properties otherwise abutting on a street.

Structure. Refers to a structure that is principally above ground and is enclosed by walls and a roof. The term includes a gas or liquid storage tank, a manufactured home or a prefabricated building. The term also includes recreational vehicles to be installed on a site for more than 180 days.

Structural Engineer. A person licensed under the laws of the State of Indiana to engage in the designing or supervising of construction, enlargement or alteration of structures or any part thereof, for others, to be constructed by persons other than himself or herself.

Structural Floodplain Management Measures. Those physically or engineering measures employed to modify the way floods behave, e.g., dams, dikes, levees, channel enlargements or diversions.

Subarea/Subbasin. Portion of a watershed divided into homogenous drainage units which can be modeled for purposes of determining runoff rates. The subareas/subbasins have distinct boundaries, as defined by the topography of the area.

Sump Pump. A small pump that discharges seepage from foundation footing drains.

Surcharge. Backup of water in a sanitary or storm sewer system in excess of the design capacity of the system.

Tailwater. The water surface elevation at the downstream side of a hydraulic structure (i.e. culvert, bridge, weir, dam, etc.).

Thalweg. The deepest point of an open channel.

Time of Concentration (t_c). The travel time of a particle of water from the most hydraulically remote point in the contributing area to the point under study. This can be considered the sum of an overland flow time and times of travel in street gutters, storm sewers, drainage channels, and all other drainage ways.

Topographic Map. Graphical portrayal of the topographic features of a land area, showing both the horizontal distances between the features and their elevations above a given datum.

Topography. The representation of a portion of the earth's surface showing natural and man-made features of a given locality such as rivers, streams, ditches, lakes, roads, buildings and most importantly, variations in ground elevations for the terrain of the area.

Tributary. Based on the size of the contributing drainage area, a smaller watercourse which flows into a larger watercourse.

Underdrain. A small-diameter perforated pipe that allows the bottom of a detention basin, channel, swale or street to drain.

Watercourse. Any river, stream, creek, brook, branch, natural or man-made drainage way in or into which stormwater runoff or floodwaters flow.

Watershed. The land area drained by contributing water to a specific point that could be along a stream, lake or other stormwater facilities. Watersheds are often broken down into subareas for the purpose of hydrologic modeling.

Watershed Area. The total area from which surface runoff is carried away by a drainage system.

Weir. A device which is used to restrict the flow of water thereby limiting the discharge rates. A weir can also facilitate calculation of measurement of the discharge rates. These are often used to control the rate of flow out of stormwater storage facilities.

Wet-Bottom Retention Facility. A facility designed to retain a permanent pool of water after having provided its planned detention of runoff during a storm event.

Wetlands. Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions and/or those wetland areas that are under the COE jurisdiction.

Sec. 1-14 General Stormwater Control Policy.

It is recognized that, with the possible exception of the major watercourses, the smaller streams and drainage channels serving the City of Brazil may not have sufficient capacity to receive and convey stormwater runoff resulting from continued urbanization. Accordingly, the storage and controlled release rate of excess stormwater runoff shall be required for all development, as defined in Section 1-13, that is located within the Brazil City limits.

(a.) <u>General Release Rates</u>

In general, the release rates of stormwater from developments and redevelopments shall be:

Post-Developed Peak Rate	Must Not Exceed	**Pre-Developed Peak Rate**
10-Year Frequency Storm		2-Year Frequency Storm
100-Year Frequency Storm		10-Year Frequency Storm

That is, the release rates for developments and redevelopments up to and including the 10-year return period storm may not exceed the predeveloped 2-year return period stormwater runoff rate. The release rate for developments for the 11 - 100-year return period storms shall not exceed the predeveloped peak 10-year return period rate.

(b.) Downstream Restrictions

In the event the natural downstream channel or storm sewer system is inadequate to accommodate the release rate provided above, then the allowable release rate shall be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by the **Brazil City Engineer**, shall be required to store that portion of the runoff exceeding the capacity of the receiving sewers or waterways.

If more than one detention/retention facility is involved in the development of the area upstream of the limiting restriction and the outlets leave the development site at different locations, the allowable release rate from any one detention basin shall be in a direct proportion to the ratio of its drainage area to the drainage area of the entire watershed upstream of the restriction.

Sec. 1-15 Determination of Impact Drainage Areas.

The **Brazil City Engineer** is authorized, but not required, to classify certain geographical areas as Impact Drainage Areas and to enact and promulgate regulations which are generally applied. In determining Impact Drainage Areas, the **Brazil City Engineer** shall consider such factors as topography, soil type, capacity of existing legal drains and distance from adequate drainage facility. The following areas shall be designated as Impact Drainage Areas, unless good reason for not including them is presented to the **Brazil City Engineer.**

(a.) A floodway or floodplain as designated by the Subdivision Ordinance of the City of Brazil.

(b.) Land within 75 feet of each bank of any regulated ditch.

(c.) Land within 75 feet of the center line of any regulated drain tile.

Land where there is not an adequate outlet, taking into consideration the capacity and depth of the outlet, may be designated as an Impact Drainage Area by resolution of the **Brazil City Council**. Special requirements for development within any Impact Drainage Area shall be included in the resolution.

Sec. 1-16 Information Requirements.

The following information shall either accompany or be presented on the plans of all development projects. All plan sheets and other information and data prepared shall be stamped by a licensed professional engineer or land surveyor engaged in storm drainage design.

(a.) Existing Condition Information (To Be Shown on Submitted Plans):

1. A title sheet shall be included with the following information: project name and location map, name, address, telephone number and seal of the registered professional engineer or licensed/registered land surveyor preparing the plans.

2. Legal description of site.

3. A topographic map of the land to be developed and such adjoining land whose topography may affect the layout or drainage of the development. The contour intervals shall be one (1) foot when slopes are less or equal to than two percent ($\leq 2\%$) and shall be two (2) feet when slopes exceed two percent ($>2\%$). All elevations shall be given in either National Geodetic Vertical Datum of 1929 (NGVD) or North American Vertical Datum of 1988 (NAVD).

   a] If the project site is less than or equal to two (2) acres in total land area, the topographic map shall include all topography of land surrounding the site to a distance of at least one hundred feet (100').

   b] If the project site is greater than two (2) acres in total land area, the topographic map shall include all topography of land surrounding the site to a distance of at least two hundred feet (200').

4. Adequate number of benchmarks shown with elevations referenced to NGVD, NAVD, to facilitate checking of elevations without more than one setup of a surveyor's level, except for large development sites where additional setups may be warranted.

5. The location of existing streams and other stormwater runoff channels.

6. One or more typical cross section of all existing channels or other open drainage facilities. Cross sections must be represented perpendicular to the expected flow path and the location indicated on the map.

7. Spot elevations shown at drainage break points.

8. Normal shoreline of lakes, ponds, swamps and detention/retention facilities, their floodplains, and direction of inflow and outflow.

9. The size and location of regulated drains, farm drains, inlets and outfalls, if any of record. Include the elevations of tile outlet inverts.

10. Storm, sanitary and combined sewers and outfalls, if any of record.

11. Septic tank systems, disposal field and outlet, if any of record.

12. Seeps, springs, flowing and other wells, that are visible or of record.

13. Roads, right-of-ways, building set backs, drainage, Regulated Drain and overhead or underground utility easements.

14. The extent of the floodplains for any stream or channel (draining more than 640 acres or 1 square mile) at the established 100-year flood elevation per FEMA maps, IDNR Recommendation Letter, or engineer's calculations, and the limits of the regulatory floodway, all properly identified and sources noted. NOTE: The regulatory floodway may be measured from the effective FEMA map; however, floodplain boundaries shall be determined based on the 100-year flood elevation/profile and the existing topography on the map (flood insurance will still be required on those portions of the FEMA designated floodplain until the applicant requests and receives a LOMR/LOMA from FEMA).

15. The extent and location of any current wetlands area located on the subject property. A plan must be submitted which details how the wetland loss will be mitigated. The developer is responsible for all necessary coordination and compliance with IDNR or COE regulations.

16. Each plan sheet shall be twenty-four inches (24") by thirty-six inches (36") in size and include the following:

a] A title block located in the lower right hand corner of each sheet that includes the project name, job number, sheet title (Geometric, Grading, etc.), sheet number, date of preparation and latest revision date and description.

b] Map scale (preferably with a scale between 1 inch = 20 feet and 1 inch = 100 feet).

c] A legend clearly identifying all symbols indicated on each sheet.

d] North arrow.

(b.) <u>Existing Condition Information (To Be Included Within a Report or as a Separate Exhibit):</u>

1. Soil names and their hydrologic classification for the proposed development when hydrologic methods requiring soils information are used.

2. Each upstream, off-site drainage area tributary to the subject site on USGS Quadrangle Maps or other more detailed topographic maps.

3. Watershed boundary delineation for each stormwater facility (storm sewer, culvert, swale, detention basin, etc.) on the subject property.

4. Copy of the effective FEMA map, annotated to show the project location and property boundaries in relation to the regulatory floodplain and floodway.

(c.) <u>Proposed Condition Information to be Shown on Submitted Plans (In Addition to Previous Plan Requirements):</u>

1. Plan to convey upstream, off-site runoff through or around the subject property.

2. Proposed contours and where they tie into existing contours.

3. Location and percentage of impervious surfaces expected when the development is completed.

4. Depth and amount of storage required by design of the new facilities.

5. Proposed layout and design of storm sewers, other storm drains including the outfall and outlet locations and (approximate) invert elevations, the receiving stream or channel and its 100-year return period water elevation.

6. Layout of swales which collect runoff from on-site and/or off-site watersheds.

7. Existing detention/retention facilities to be maintained, enlarged, or otherwise altered and new ponds or basins to be built.

8. Proposed culverts and bridges - include elevations, waterway openings.

9. Identification of overland flow routes to detention/retention facilities.

10. New channels or other open drainage facilities to be constructed, their locations, cross sections and profiles. Cross sections should be represented perpendicular to the expected flow path.

11. Interim drainage plan which is to be incorporated into the development pending completion of the development and the final drainage plan.

12. All proposed underground and overhead utility and drainage easements.

13. Parts of the proposed street system where pavements are planned to be depressed sufficiently to convey or temporarily store overflow from storm sewers and over the curb runoff resulting from the heavier rainstorms and the outlets for such overflow.

14. Slope, type and size of all sewers and other waterways. Plan and profile of all storm sewers and culverts must also be submitted..

15. Erosion Control Plan.

(d.) <u>Proposed Condition Information (To be Included Within a Report or as a Separate Exhibit):</u>

The report should be comprehensive and detail all the steps which the designer took during the design process and how the design satisfies the requirements of this ordinance. The report should include:

1. A description of the present land use as well as proposed land use.

2. Hydrologic and hydraulic information detailing existing and proposed drainage patterns on the subject site, **along with any off-site drainage entering the site**. All hydrologic and hydraulic computation should be included in the report. These calculations should include, but not be limited to: development of runoff curve numbers or runoff coefficients, runoff calculations, stage-discharge, relationships for detention/retention facility outfalls, storage volume, times of concentration.

   Note that off-site drainage include *all* flow types which discharge to the subject site, including discharge in pipes, open channels and sheet flow.

3. Watershed boundary delineation for each proposed stormwater facility (storm sewer, culverts, swale, detention basin, etc.).

4. For all detention/retention facilities, a plot or tabulation of storage volumes with corresponding water surface elevations and a plot or tabulation of the facility outfall rates for those water surface elevations.

5. Copies of all computer model runs used in the drainage analyses. These computer runs should include both the model inputs and the outputs. A floppy diskette with input files may expedite the review process.

6. Discussion of significant drainage problems associated with the project and assumptions associated with procedures used to evaluate and propose solutions to these problems.

Sec. 1-17 Submittal and Consideration.

Two sets of preliminary, proposed final drainage plans and/or construction plans as detailed in Section 1-16 shall be submitted to the **Brazil City Engineer**. All preliminary plans, final plans and construction plans shall be reviewed by the **Brazil City Engineer** for compliance with the standards of this ordinance.

Upon completion of their review, the **Brazil City Engineer** may either approve or deny each project. If the **Brazil City Engineer** approve a project, then three copies of the approved project plans will receive the signature and approval stamp of both the **Brazil City Engineer**. Two copies of such plans will be returned to the applicant, one copy will be kept on file at the **Office of the Brazil City Engineer**.

The **Brazil City Engineer**, as appointees of the **Brazil City Council**, is authorized to review engineering summaries of projects or other written explanations for a variance to the requirements of this ordinance and based upon the same, make a recommendation to the **Brazil City Council** concerning the variance. The **Brazil City Council** may grant exemptions from any and all requirements of this ordinance and/or waive any requirements of this ordinance. Any applicant or other party affected by any approval or denial of the Drainage Permit may appeal the decision to the **Brazil City Council**.

Where the outfall from the stormwater drainage system of any developer flows through real estate owned by other landowners prior to reaching a regulated drain or natural waterway, no approval shall be granted for such stormwater drainage system until all impacted owners either consent in writing to such use of their real estate or are notified of such proposal and their rights to appeal any approval of the design. Proof of this notification must be submitted to the **Brazil City Engineer**.

Sec. 1-18 Methodology for Determination of Pre- and Post- Development Runoff Quantities

Runoff quantities shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel under development. The quantity of runoff which is generated as the result of a given rainfall intensity may be calculated as follows:

(a.) <u>Development Sites Less Than or Equal to 5 Acres in Size, With a Contributing Drainage Area Less Than or Equal to 50 Acres and No Depressional Storage</u>

The Rational Method may be used. In the Rational Method, the peak rate of runoff, Q, in cubic feet per second (cfs) is computed as:

$$Q = CIA$$

Where:

C = Runoff coefficient, replacing the characteristics of the drainage area and defined as the ratio of runoff to rainfall.

I = Average intensity of rainfall in inches per hour for a duration equal to the time of concentration (tc) for a selected rainfall frequency.

A = Tributary drainage area in acres.

Values for the runoff coefficient "C" are provided by Tables 1 and 2, which show values for different types of surfaces and local soil characteristics. The composite "C" value used for a given drainage area with various surface types shall be the weighted average value for the total area calculated from a breakdown of individual areas having different surface types.

In the instance of undeveloped land situated in an upstream area, a coefficient or coefficients shall be used which are related to the use or uses which can be reasonably anticipated after development occurs. Interpolation, extrapolation and adjustment for local conditions shall be based on engineering experience and judgement.

Rainfall intensity shall be determined from the rainfall frequency data shown in Table 3 (at end of Section 1-19). In general , the **time of concentration (t_c)** methodology to be used for all stormwater management projects within the City of Brazil shall be as outlined in the U.S. Department of Agriculture (USDA) - NRCS TR-55 Manual.

In urban or developed areas, the methodology to be used shall be the sum of the inlet time and flow time in the stormwater facility from the most remote part of the drainage area to the point under consideration. The **flow time** in the storm sewers may be estimated by distance in feet divided by velocity of flow in feet per second. The **velocity** shall be determined by the Manning's Equation (see Section 1-20). **Inlet time** is the combined time required for the runoff to reach the inlet of the storm sewer. It includes overland flow time and flow time through established surface drainage channels such as swales, ditches and sheet flow across such areas as lawns, fields and other graded surfaces.

(b.) <u>Development Sites Greater Than 5 Acres in Size **or** Contributing Drainage Area Greater Than 50 Acres **or** With Significant Depressional Storage</u>

The runoff rate for these development sites and contributing drainage areas shall be determined by a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies and the Huff Third Quartile (50%) Rainfall Distribution. A sample time of concentration sheet can be found in Figure 1 and TR-55 Curve Numbers are given in Tables 5a-5d. Hydrologic soil groups for each soil present in the City of Brazil are given in Table 6. Rainfall depths for various frequencies and durations shall be taken from Table 7. The Huff Third Quartile (50%) is found in Table 8. Examples of computer models that can generate such hydrographs include TR-20 (NRCS), and HEC-1 (COE).

Other models may be acceptable and should be approved by the **Brazil City Engineer** prior to their utilization.

(c.) Development Sites with Drainage Areas Greater Than or Equal to One Square Mile

For the design of any major drainage system as defined in Section 1-13, the discharge must be obtained from the IDNR. Other portions of the site must use the discharge methodology in the applicable section of this Article.

Sec. 1-19 Methodology for Determination of Detention Storage Volumes.

(a.) Development Sites Less Than or Equal to 5 Acres in Size, With a Contributing Drainage Area Less Than or Equal to 50 Acres and No Depressional Storage

The required volume of stormwater storage may be calculated using the Rational Method and based on the runoff from a 100-year return period storm. A computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies may also be used with the duration storm that produces the highest runoff volume.

The following 11-step procedure, based on the Rational Method, may be used to determine the required volume of storage. Alternatively, the worksheet labeled as Figure 2 may be completed to determine the required volume of storage.

Step Procedure

1. Determine total drainage area in acres "A".

2. Determine composite runoff coefficient "C_u" based on existing land use.

3. Determine time of concentration "t_c" in minutes based on existing conditions.

4. Determine rainfall intensity "I_u" in inches per hour, based on time of concentration and using data given in Table 3 for the 2-year/10-year return periods.

5. Compute runoff based on existing land use and 2-year/10-year return periods. $Q_u = C_u I_u A_u$.

6. Determine composite runoff coefficient "C_d" based on developed conditions and a 100-year return period.

7. Determine 100-year return rainfall intensity "I_d" for various storm durations "t_d" up through the time of concentration for the developed area using Table 3. If the desired time of concentration is not listed in Table 3, it can be calculated using the parameters found in Table 4 with the following equation.

$$I_d = \frac{c\,(T_r)^a}{(t+d)^b}$$

Where: c, a, d and B are regional coefficients determined by rainfall intensity-duration-frequency curves, T_r is the recurrence interval (in years), and t corresponds to the time of concentration (in hours).

8. Determine developed inflow rates "Q_d" for various storm durations times "t_d" up through the time of concentration of the developed area.

$$Q_d = C_d 1_d A_d$$

9. Compute a storage rate "S (t_d)" for various storm durations "t_d" up through the time of concentration of the developed area.

$$S\,(t_d) = Q_d - Q_u$$

10. Compute required storage volume "S_r" in acre-feet for each storm duration "t_d". This assumes a triangular hydrograph of duration (2*t_d) hours with a peak flow of S (t_d) at t_d hours.

$$S_R = S\,(t_d)\ t_d/12$$

11. Select largest storage volume computed in Step 10 for any storm duration "t_d" for detention basin design.

(b.) Development Sites Greater Than 5 Acres in Size or Contributing Drainage Area Greater Than 50 Acres or With Significant Depressional Storage

All runoff detention storage calculations for these development sites shall be prepared using a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies. The Huff Third Quartile (50%) rainfall distribution and that storm duration, up to and including the 24-hour storm duration, that gives the highest required storage volume shall be utilized. The allowable release rates shall be based on the storm durations which give the greatest discharge in the pre-developed condition. Examples of computer models that can generate such hydrographs include TR-20 (NRCS), and HEC-1 (COE). Other models may be acceptable and should be approved by the **Brazil City Engineer** prior to their utilization.

Sec. 1-20 Storm Sewer Design Standards and Specifications.

All storm sewers, whether private or public, and whether constructed on private or public property shall conform to the design standards and other requirements contained herein.

(a.) Design Storm Frequencies

1. All storm sewers, inlets, catch basins and street gutters shall accommodate, as a minimum, peak runoff from a 10-year return frequency storm. Additional discharges to storm sewer systems allowed in sub-section (1) of this Section must be considered in all design calculations. For Rational Method analysis, the duration shall be equal to the time of concentration for the drainage area. In computer based analysis, the duration is as noted in the applicable methodology associated with the computer program.

2. Culverts shall be capable of accommodating peak runoff from a 24-hour, 50-year frequency storm when crossing under a road which is part of the INDOT Rural Functional Classification System or is classified as freeway, arterials, and/or collectors by the **City of Brazil Zoning Ordinance** or provides the only access to and from any portion of any commercial or residential developments.

3. For portions of the system considered minor drainage systems, the allowable spread of water on Collector Streets is limited to maintaining two clear 10-foot moving lanes of traffic. One lane is to be maintained on Local Roads, while other access lanes (such as a subdivision cul-de-sac) can have a water spread equal to one-half of their total width.

4. Facilities functioning as a major drainage system as defined in Section 1-13 must also meet IDNR design standards.

(b.) Manning's Equation

Determination of hydraulic capacity for storm sewers sized by the Rational Method analysis must be done using Manning's Equation. Where:

$$V = (1.486/n)\ R^{2/3}\ S^{1/2}$$

Then: $Q = VA$

Where:

Q = capacity in cubic feet per second

V = mean velocity of flow in feet per second

A = cross sectional area in square feet

R = hydraulic radius in feet

s = slope of the energy grade line in feet per foot

n = Manning's "n" or roughness coefficient

The hydraulic radius, R, is defined as the cross sectional area of flow divided by the wetted flow surface or wetted perimeter. Allowable "n" values are maximum permissible velocities for storm sewer materials are listed in Table 9.

(c.) Backwater Method for Pipe System Analysis

For hydraulic analysis of existing or proposed storm drains which possess submerged outfalls, a more sophisticated design/analysis methodology than Manning's equation will be required. The backwater analysis method provides a more accurate estimate of pipe flow by calculating individual head losses in pipe systems which are surcharged and/or have submerged outlets. These head losses are added to a known downstream water surface elevation to give a design water surface elevation for a given flow at the desired upstream location. Total head losses may be determined as follows:

Total head loss = frictional loss + manhole loss + velocity head loss + junction loss

Various computer modeling programs such as HYDRA, ILLUDRAIN, and STORMCAD are available for analysis of storm drains under these conditions. Computer models to be utilized, other than those listed, must be approved by the **Brazil City Engineer**.

(d.) Minimum Size for Storm Sewers

The minimum diameter of all storm sewers shall be 12 inches. The rate of release for detention storage shall be controlled by an orifice plate or other device, subject to approval of the **Brazil City Engineer**, when the minimum 12 inch diameter pipe will not limit the rate of release to the required amount.

(e.) Pipe Cover and Grade

Sewer grade shall be such that, in general, a minimum of one and one-half (1.5) feet of cover is maintained over the top of the pipe. If the pipe is to be placed under pavement, then the minimum pipe cover shall be two (2.0) feet from the top of pavement to top of pipe. Pipe cover less than the minimum may be used only upon written approval from the **Brazil City Engineer**. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Final grade shall be set with full consideration of the capacity required, sedimentation problems and other design parameters. Minimum and maximum allowable slopes shall be those capable of producing velocities of between 2.5 and 15 feet per second, respectively, when the sewer is flowing full. Maximum permissible velocities for various storm sewer materials are listed in Table 9.

(f.) Alignment

Storm sewers shall be straight between manholes and/or inlets.

(g.) Manholes/Inlets

Manholes and/or inlets shall be installed to provide human access to continuous underground storm sewers for the purpose of inspection and maintenance. The casting access minimum inside diameter shall be no less than 22 inches or a rectangular opening of no less than 22 inches. Manholes shall be provided at the following locations:

1. Where two or more storm sewers converge.

2. Where pipe size changes.

3. Where a change in horizontal alignment occurs.

4. Where a change in pipe slope occurs.

5. At intervals in straight sections of sewer, not to exceed the maximum allowed.

The maximum distance between storm sewer manholes shall be as follows:

Size of Pipe (Inches)	Maximum Distance (Feet)
12 through 42	400
48 and Larger	600

In addition to the above requirements, a minimum drop of 0.1 foot through manholes should be provided. **When changing pipe size, match crowns of pipes.** Pipe slope should not be so steep that inlets surcharge (i.e. hydraulic grade line below rim elevation.

6. Manhole/inlet sizing shall be as follows:

Depth of Structure	Minimum Diameter	Minimum Square Opening
0-3 feet	24 inches	24" x 24"
3-5 feet	36 inches	36" x 36"
5 or more feet	48 inches	48" x 48"

(h.) <u>Inlet Sizing and Spacing</u>

Inlets or drainage structures shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels or culverts. The inlet grate opening provided shall be adequate to pass the design 25-year flow with 50% of the sag inlet areas clogged. An overload channel from sag inlets to the overflow channel or basin shall be provided at sag inlets, so that the maximum depth of water that might be ponded in the street sag shall not exceed 6 inches during the 25-year frequency storm event. Inlet design and spacing may be done using the hydraulic equations by manufacturers or office/weir equations. Use of the U.S. Army Corps of Engineers HEC-12 computer program is also an acceptable method. Gutter spread on continuous grades may be determined by using the Manning's equation, or by using Figure 3.

(i.) Workmanship

The specifications for the construction of storm sewers shall not be less stringent than those set forth in the latest edition of the INDOT, "Standard Specifications". Additionally, ductile iron pipe shall be laid in accordance with American Water Works Association (AWWA) C-600 and clay pipe shall be laid in accordance with either American Society of Testing Materials (ASTM) C-12 or the appropriate American Association of State Highway and Transportation Officials (AASHTO) specifications. Variations from these standards must be justified and receive written approval from the **Brazil City Engineer**.

(j.) Materials

Storm sewer manholes and inlets shall be constructed of cast in place concrete or precast reinforced concrete. Materials and construction shall conform to the latest edition of the Indiana Department of Transportation (INDOT) "Standard Specifications", Section 720.

Pipe and fittings used in storm sewer construction shall be extra-strength clay pipe (ASTM C-12), ductile iron pipe (AWWA C-151), poly vinyl chloride pipe (AASHTO M252), polyethylene pipe (AASHTO M252 or AASHTO M294) or concrete pipe (AASHTO M170). Other pipe and fittings not specified herein or in Sections 907-908 of the latest edition of the INDOT "Standard Specifications" may be used only when specifically authorized by the **Brazil City Engineer**. Pipe joints shall be flexible and watertight and shall conform to the requirements of Section 906, of the latest edition of the INDOT "Standard Specifications".

(k.) Special Hydraulic Structures

Special hydraulic structures required to control the flow of water in storm runoff drainage systems include junction chambers, drop manholes, inverted siphons, stilling basins and other special structures. The use of these structures shall be limited to those locations justified by prudent planning and by careful and thorough hydraulic engineering analysis. Certification of special structures by a certified Structural Engineer may also be required.

(l.) Connections to Storm Sewer Systems

To allow any connections to the storm sewer system, provisions for the connections shall be shown in the drainage calculations for the system. Specific language shall be provided in the protective covenants, on the record plat, or with the parcel deed of record, noting the ability or inability of the system to accommodate any permitted connections, for example, sump pumps and footing drains.

1. **Sump pumps** installed to receive and discharge groundwaters or other stormwaters shall be connected to the storm sewer where possible or discharged into a designated storm drainage channel. Sump pumps installed to receive and discharge floor drain flow or other sanitary sewage shall be connected to the sanitary sewers. A sump pump shall be used for one function only, either the discharge of stormwaters or the discharge of sanitary sewage.

2. **Footing drains** shall be connected to storm sewers where possible or designated storm drainage channels. No footing drains or drainage tile shall be connected to the sanitary sewer.

3. No **roof downspouts**, roof drains, nor roof drainage piping shall be connected to the storm drainage system. No down spouts or roof drains shall be connected to the sanitary sewers.

4. **Basement floor drains** shall be connected to the sanitary sewers.

In addition, none of the above mentioned devices shall be connected to any street underdrains.

(m.) Maintenance Responsibilities

Maintenance of stormwater facilities during construction and thereafter, shall be the responsibility of the land developer/owner. **Assignment of responsibility for maintaining facilities serving one or more lot(s) or holding(s) shall be documented by appropriate covenants to property deeds *and* documented in sales agreements, unless responsibility is formally accepted by a public body.**

Sec. 1-21 Open Channel Design Standards and Materials

All open channels, whether private or public, and whether constructed on private or public land, shall conform to the design standards and other design requirements contained herein.

(a.) Design Storm Frequencies

1. All open channels and swales shall accommodate, as a minimum, peak runoff from a 10-year return frequency storm. For Rational Method analysis, the storm duration shall be equal to the time of concentration for the drainage area. In computer-based analysis, the duration is as noted in the applicable methodology associated with the computer program.

2. Open channels with a carrying capacity of more than 30 cfs at bank-full stage shall be capable of accommodating peak runoff for a 24-hour, 50-year return frequency storm within the drainage easement.

3. Open channel facilities functioning as a major drainage system as defined in Section 1-13 must also meet IDNR design standards.

(b.) Manning's Equation

The waterway for channels shall be determined using Manning's Equation, where:

$$Q = (1.486/n)\ A\ R^{2/3}\ S^{1/2}$$

Q = Discharge in cubic feet per second (cfs)

A = Waterway area of channel in square feet

Parameters R, S and n are explained in Section 1-20 (b).

(c.) Channel Cross-Section and Grade

1. The required channel cross-section and grade are determined by the design capacity, the material in which the channel is to be constructed, and the requirements for maintenance. A minimum depth may be required to provide adequate outlets for subsurface drains, tributary ditches, or streams. The channel grade shall be such that the velocity in the channel is high enough to prevent siltation but low enough to prevent erosion. Velocities less than 2 feet per second are not acceptable, as siltation will taken place and ultimately reduce the channel cross-section. The maximum permissible velocities in vegetated-lined channels are shown in Table 10. In addition to existing runoffs, the channel design should incorporate increased runoff due to the proposed development.

2. Where depth of design flow is slightly below critical depth, channels shall have freeboard adequate to cope with the effect of hydraulic jumps.

3. Minimum swale slopes are 0.3%. All flow shall be confined to the specific easements associated with each rear and side lot swale that are part of the minor drainage system. Swales with slopes less than 0.8% shall have tile underdrains to dry the swales.

4. If roadside ditches are used rather than storm sewers, the bottom of the ditch should be low enough to install adequately sized driveway culverts without creating "speed bumps". The driveway culvert inverts shall be designed to adequately consider upstream and downstream culvert elevations.

5. Flow of an open channel into a closed system is prohibited, unless quantity and head loss computations demonstrate the closed conduit to be capable of carrying all the open channel flow with no reduction of velocity.

(d.) <u>Side Slopes</u>

1. Earthen channel side slopes shall be no steeper than 3 horizontal to 1 vertical (3:1). Flatter slopes may be required to prevent erosion and for ease of maintenance.

2. Where channels will be lined, side slopes shall be no steeper than 1 ½ horizontal to 1 vertical (1.5:1) with adequate provisions made for weep holes.

3. Side slopes steeper than 1 ½ horizontal to 1 vertical (1.5:1) may be used for lined channels provided that the side lining is designed and constructed as a structural retaining wall with provisions for live and dead load surcharge.

4. When the design discharge produces a depth of greater than three feet (3') in the channel, appropriate safety precautions shall be added to the design criteria based on reasonably anticipated safety needs.

(e.) <u>Channel Stability</u>

1. Characteristics of a stable channel are:

   (a.) It neither promotes sedimentation or degrades the channel bottom and sides beyond tolerable limits.

(b.) The channel banks do not erode to the extent that the channel cross-section is changed appreciably.

(c.) Excessive sediment bars do not develop.

(d.) Excessive erosion does not occur around culverts, bridges, outfalls, or elsewhere.

(e.) Gullies do not form or enlarge due to the entry of uncontrolled flow to the channel.

2. Channel stability shall be determined for an aged condition and the velocity shall be based on the design flow or the bankfull flow, whichever is greater, using an "n" value for the various channel linings as shown in Table 10 of this Article. In no case is it necessary to check channel stability for discharges greater than that from a 100-year frequency storm.

3. Channel stability shall be checked for conditions immediately after construction. For this stability analysis, the velocity shall be calculated for the expected flow from a 10-year frequency storm on the watershed, or the bankfull flow, whichever is smaller, and the "n" value for the newly constructed channels in the fine-grained soils and sands may be determined in accordance with the "National Engineering Handbook 5, Supplement B, Soil Conservation Service" and shall not exceed 0.025. This reference may be obtained by contacting the National Technical Information Service in Springfield, Virginia at 703-487-4650. The allowable velocity in the newly constructed channel may be increased by a maximum of 20 percent to reflect the effects of vegetation to be established under the following conditions:

a] The soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion controlling vegetation.

b] Species of erosion controlling vegetation adapted to the area, and proven methods of establishment are shown.

c] The channel design includes detailed plans for establishment of vegetation on the channel side slopes.

(f.) Drainage of Waterways

Vegetated waterways that are subject to low flows of long duration or where wet conditions prevail shall be drained with a tile system or by other means such as paved gutters. Tile lines may be outletted through a drop structure at the ends of the waterway or through a standard tile outlet.

(g.) Appurtenant Structures

The design of channels will include provisions for operation and maintenance and the proper functioning of all channels, laterals, travelways and structures associated with the project. Recessed inlets and structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the design of channel improvements. The design will also provide for necessary flood gates, water level control devices, and any other appurtenance structure affecting the functioning of the channels and the attainment of the purpose for which they are built.

The effects of channel improvements on existing culverts, bridges, buried cables, pipelines and inlet structures for surface and subsurface drainage on the channel being improved and laterals thereto shall be evaluated to determine the need for modification or replacement. Culverts and bridges which are modified or added as part of the channel improvement projects shall meet reasonable standards for the type of structure, and shall have a minimum capacity equal to the design discharge or governmental agency design requirements, whichever is greater.

(h.) Deposition of Spoil

Spoil material resulting from clearing, grubbing and channel excavation shall be disposed of in a manner which will:

1. Minimize overbank wash.

2. Provide for the free flow of water between the channel and floodplain boundary unless the valley routing and water surface profiles are based on continuous dikes being installed.

3. Not hinder the development of travelways for maintenance.

4. Leave the right-of-way in the best condition feasible, consistent with the project purposes, for productive use by the owner.

5. Be approved by the IDNR or COE, whichever is applicable, if deposited in the floodway.

(I.) <u>Materials</u>

Materials acceptable for use as channel lining are:

1. Grass
2. Revetment Riprap
3. Concrete
4. Hand Laid Riprap
5. Precast Cement Concrete Riprap
6. Grouted Riprap
7. Gabions
8. Straw or Coconut Matting (only until grass is established)

Other lining materials must be approved in writing by the **Brazil City Engineer**. Materials shall comply with the latest edition of the INDOT, "Standard Specifications".

(j.) Maintenance Responsibilities

Maintenance of open channels during construction and thereafter, shall be the responsibility of the land developer/owner. **Assignment of responsibility for maintaining facilities serving one or more lot(s) or holding(s) shall be documented by appropriate covenants to property deeds *<u>and</u>* documented in sales agreements, unless responsibility is formally accepted by a public body.**

Sec. 1-22 Stormwater Detention Design Standards.

The following shall govern the design of any improvement with respect to the detention of stormwater runoff. Basins shall be constructed to temporarily detain the stormwater runoff which exceeds the maximum peak release rate authorized by this Ordinance. The required volume of storage provided in these basins, together with such storage as may be authorized in other onsite facilities, shall be sufficient to control excess runoff from the 10-year or 100-year storm as explained below in Part (b) of this Section. Also, basins shall be constructed to provide adequate capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings.

(a.) Acceptable Detention Facilities

The increased stormwater runoff resulting from a proposed development should be detained onsite by the provisions of appropriate wet bottom or dry bottom detention facilities, parking lots, or other acceptable techniques. Measures which retard the rate of overland flow and the velocity in runoff channels shall also be used to partially control runoff rates.

(b.) Allowable Release Rates

Control devices shall limit the discharge to a rate such that the release rate from the site is no greater than the 2-year predeveloped rate for 0-10 year return interval storms and the 10-year predeveloped rate for 11-100 year return interval storms. That is, all storms up to and including the 10-year return period storm must be detained at a release rate below the predeveloped peak 2-year return period stormwater runoff rate. The release rate for developments and redevelopments for the 11-100 year return period storms shall not exceed the predeveloped peak 10-year return period rate. As stated in Section 1-14, the allowable release rates may be reduced from these levels if downstream restrictions exist.

(c.) Drainage System Overflow Design

Drainage systems, including all ditches, channels, conduits, swales, etc., shall have adequate capacity to convey the stormwater runoff from all upstream tributary areas (off-site land areas) through the development under consideration for a 100-year return period design storm calculated on the basis of the upstream land use in its present state of development. Swales between privately owned residential lots shall not be used to convey the above referenced stormwater runoff unless the discharge paths are confined within the drainage easements and/or common areas. In the case of existing upstream detention, an allowance equivalent to the reduction in flow rate provided may be made for upstream detention only when: (1) such detention and release rate have previously been approved by the **City of Brazil Official** charged with the approval authority at the time of the approval, and (2) evidence of its construction and maintenance can be shown.

(d.) General Detention Basin Design Requirements

Basins should be designed to collect sediment and debris in specific locations so that removal costs are kept to a minimum.

1. The maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of 48 hours form the start of the storm unless additional storms occur within the period.

2. All stormwater detention facilities shall be separated by not less than 25 feet from any building or structure to be occupied.

3. No detention facility or other water storage area, permanent or temporary, shall be constructed under or within twenty feet (20') of any pole or high voltage electric line. Likewise, poles or high voltage electric lines shall not be placed within twenty feet (20') of any detention facility or other water storage area.

4. All stormwater detention facilities shall be separated from any road by no less than one right-of-way width, measured from the top of bank, using the most restrictive right-of-way possible. If the width of the right-of-way is less than 50 feet, then the minimum distance between top of bank and road shall be increased to 50 feet.

5. No slopes steeper than 3 horizontal to 1 vertical (3:1) for safety, erosion control, stability and ease of maintenance shall be permitted.

6. Safety screens having a maximum opening of four inches (4") shall be provided for any pipe or opening to prevent children or large animals from crawling into the structures.

7. Danger signs shall be mounted at appropriate locations to warn of deep water, possible flood conditions during storm periods and other dangers that exist. Fencing shall be provided if deemed necessary by the **Brazil City Engineer.**

8. Outlet control structures shall be designed to operate as simply as possible and shall require little or no maintenance and/or attention for proper operation. They shall limit discharges into existing or planned downstream channels or conduits so as not to exceed the predetermined maximum authorized peak flow rate.

9. Emergency overflow facilities such as a weir or spillway shall be provided for the release of exceptional storm runoff or in emergency conditions should the normal discharge devices become totally or partially inoperative. The overflow facility shall be of such design that its operation is automatic and does not require manual attention.

a] Off-site flows greater than the rate produced by the 10-year storm in the post-developed condition shall be conveyed through the emergency spillway, *not* through the primary outlet structure.

b] Emergency overflow facilities shall be designed to handle one and one-quarter (1.25) times the peak discharge and peak flow velocity resulting from the 100-year design storm event runoff from the entire contributing watershed, assuming post-development condition, draining to the detention/retention facility.

10. Grass or other suitable vegetative cover shall be provided along the banks of the detention storage basin. Grass should be cut regularly at approximately monthly intervals during the growing season or as required to maintain the facility.

11. Debris and trash removal and other necessary maintenance shall be performed on a regular basis to ensure continued operation in conformance to design.

12. No residential lots or any part thereof, shall be used for any part of a detention basin or for the storage of water, either temporary or permanent, unless that part of a lot is located within an easement. The easement must be of sufficient width, as determined by the **Brazil City Engineer,** to perform routine maintenance activities.

(e.) Additional Requirements for Wet-Bottom Facility Design

Where part of a detention facility will contain a permanent pool of water, all of the items required for detention storage, and in parts (g) and (h) above, shall apply except that the system of drains with a positive gravity outlet required to maintain a dry bottom facility will not be required. A controlled positive outlet will be required to maintain the design water level in the wet bottom facility and provide required detention storage above the design water level. However, the following additional conditions shall apply:

1. Facilities designed with permanent pools or containing permanent lakes shall have a water area of at least one-half (0.5) acre. If fish are to be used to keep the pond clean, a minimum depth of approximately ten feet (10') shall be maintained over at least 25 percent of the pond area. The remaining lake area shall have no extensive shallow areas, except as required by subsection 3 below.

2. A safety ledge four (4) to six (6) feet in width is required and shall be installed in all lakes approximately 30 to 36 inches below the permanent water level. In addition, a similar maintenance ledge 12 to 18 inches above the permanent water line shall be provided. The slope between the two ledges shall be stable and of a material such as stone or riprap which will prevent erosion due to wave action.

3. A safety ramp exit from the lake shall be required in all cases and shall have a minimum width of twenty feet (20') and exit slope of 6 horizontal to 1 vertical (6:1). The ramp shall be of a material that will prevent its deterioration due to vehicle use or wave action such as a concrete block chute or a cellular confinement system filled with #53 aggregate with a geotextile fabric underlay. Any other construction materials shall receive prior approval from the **Brazil City Engineer.**

4. Periodic maintenance is required in lakes to control weed and larval growth. The facility shall also be designed to provide for the easy removal of sediment which will accumulate during periods of reservoir operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather may also be required.

5. Aeration facilities to prevent pond stagnation shall be considered in all designs. Design calculations to substantiate the effectiveness of any aeration facilities shall be submitted with final engineering plans. Agreements for the perpetual operation and maintenance of aeration facilities shall be prepared to the satisfaction of the **Brazil City Engineer.**

6. For visual clarification, refer to Figures 4 and 5.

(f.) <u>Additional Requirements for Dry-Bottom Facility Design</u>

Detention facilities which will not contain a permanent pool of water shall comply with the following requirements:

1. Provisions shall be incorporated into facilities for complete interior drainage of dry bottom facilities, including the provisions of natural grades to outlet structures, longitudinal and transverse grades to perimeter drainage facility, paved gutters, or the installation of subsurface drains.

2. For residential developments, the maximum planned depth of stormwater stored shall not exceed four feet (4').

3. In excavated detention facilities, a minimum side slope of 3:1 shall be provided for stability. In the case of valley storage, natural slopes may be considered to be stable.

(g.) Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage of stormwaters on all or a portion of their surface.

Outlets for parking lot storage of stormwaters will be designed so as to empty the stored waters slowly. Depths of stored water shall be limited to a maximum depth of seven inches (7") so as to prevent damage to parked vehicles and so that access to parked vehicles is not impaired. Ponding should, in general, be confined to those positions of the parking lots farthest from the area served.

(h.) Detention Facilities in Floodplains

If detention storage is provided within a 100-year floodplain, only the net increase in storage volume above that which naturally existed on the floodplain shall be credited to the development. No credit will be granted for volumes below the elevation of the regulatory flood at the location unless compensatory storage is also provided.

(i.) Facility Financial Responsibilities

The construction costs of stormwater control systems and required facilities which are identified in the Subdivision Ordinance of the City of Brazil shall be accepted as part of the cost of land development.

(j.) Facility Maintenance Responsibilities

Maintenance of detention/retention facilities during construction and thereafter, shall be the responsibility of the land developer/owner. **Assignment of responsibility for maintaining facilities serving one or more lot(s) or holding(s) shall be documented by appropriate covenants to property deeds *and* documented in sales agreements, unless responsibility is formally accepted by a public body.**

(k.) Joint Development of Control Systems

Stormwater control systems may be planned and constructed jointly by two or more developers as long as compliance with this ordinance is maintained.

(l.) Diffused Outlets

When the allowable runoff is released in an area that is susceptible to flooding or erosion, the developer may be required to construct appropriate storm drains through such area to avert increased flood hazard caused by the concentration of allowable runoff at one point instead of the natural overland distribution. The requirements of diffused outlet drains shall be at the discretion of the **Brazil City Engineer.**

(m.) IDNR Requirements

All designs for basins to be constructed in the floodway of a stream with a drainage area of one square mile or more must also satisfy IDNR permit requirements.

Sec. 1-23 Miscellaneous Design Criteria.

(a.) Grading and Building Pad Elevations

Maximum yard slopes are 3:1 where soil has been disturbed during construction processes. Top of foundation must be no less than 6 inches above finished grade and a minimum of 15 inches above an adjacent road elevation unless a written variance in granted by either the **Brazil City Engineer.**

For all structures located in the SFHA as shown on the FEMA maps, the lowest floor elevations of all residential, commercial or industrial buildings, shall be such that all floors, including basement, shall be at the flood protection grade and therefore have 2 feet of freeboard above the 100-year flood elevation.

The low entry elevation for residential buildings outside the 100-year floodplain shall have two feet (2") of freeboard above the 100-year under proposed conditions.

(b.) Subsurface Drain Tile for Subdivisions

All residential subdivisions shall require a perforated subsurface drain tile system in addition to the storm sewer system for the purpose of lowering the water table. Such drain tiles shall be no less than 8 inches in diameter. All lots will have a subsurface drain tile on the lot or within adjoining easements to serve said lot. The preferred location of all subsurface drain tile is to be near the proposed area that the septic system will be located, if septic systems are used.

Subsurface inlets will be periodically located on the subsurface drain tile line for inspection purposes only in order to locate any problem areas that may occur. The subsurface drain tile system may be tied into the storm sewer system, but must be accounted for in the storm sewer calculations. The subsurface drain tile cannot be used for stormwater storage. All lines must have a positive flow above the hydraulic grade line of main line sewers and detention basins. The size of the subsurface drainage tile shall not be any less than:

Number of Lots Allowed Per Pipe Size		**Tile or Pipe Diameter (Inches)**
N - Value = 0.010	**N - Value = 0.017**	
1 - 10	1 - 5	8
11 - 17	6 - 11	10
17 - 28	12 - 17	12

(c.) Structures Near Regulated Drains

For regulated drains not located in platted subdivisions, unless otherwise approved by the **Brazil City Engineer**, no permanent structure shall be erected within seventy-five feet (75') measured at right angles from a) the existing top edge of each bank of a regulated open drain, as determined by the **Brazil City Engineer**; or b) the center line of a tiled Regulated Drain.

Sec. 1-24 Easement Requirements

There shall be no trees or shrubs planted, nor any structures erected in any drainage easement, unless otherwise provided by the **Brazil City Engineer**. In the case of pipes, the following access easements must be dedicated to the **City of Brazil**:

Pipe Diameter (inches)	**Pipe Depth (feet)**	**Minimum Easement Width (feet)**
15 - 24	6	20
greater than 24	10	25

(a.) Subdivisions

1. Each lot owner shall be responsible for maintenance, including replacement or repair of any drainage facility situated on such land owner's lot. The maintenance of any drainage facility located on a common area not owned by any one lot owner shall be the joint and several responsibility of all lot owners located within the subdivision.

2. Said new drain shall be placed in a minimum twenty foot (20') easement and shall be designated on the recorded plat as twenty feet (20') Drain Easement.

3. See Section 1-30 for statements that shall become part of the Restrictive Covenants of every platted subdivision.

(b.) Establishment of New Regulated Drain

This Section is Not Applicable.

Sec. 1-25 Erosion and Sediment Control

The **Brazil City Engineer** will require an erosion control plan to be submitted as part of the construction plans and specifications.

(a.) Plans for erosion and sediment control for all developments shall include the following:

1. Temporary erosion control measures, necessary during the initial construction and establishment phases up to final site grading and seeding.

2. A permanent erosion control plan of all the graded and non-hard surface areas within the proposed development, as planned for completion, up to and including seeding of the final lot on which business or residential dwellings are to be placed.

3. Details concerning removal of temporary erosion control devices after the initial establishment of adequate vegetative cover.

4. Maintenance procedures and responsible parties, as part of the continuing plan, to keep all of the land under adequate cover and erosion at an acceptable minimum.

(b.) Erosion and sediment control shall follow the guidelines and specifications outlined in the "Indiana Handbook for Erosion Control in Developing Areas, Guidelines for Protecting Water Quality Through the Control of Soil Erosion and Sedimentation on Construction Sites", published by the Division of Soil Conservation, IDNR (October 1992).

(c.) Runoff and erosion control systems shall be installed as soon as possible and maintained during the course of site development and home construction.

(d.) In addition to submitting a copy of the erosion and sediment control plan to the **Brazil City Engineer**, the applicant must forward a copy of the erosion and sediment control plan to the Brazil City Council. The **Brazil City Engineer** will verify that a copy of the erosion and sediment control plan is on file at the City of Brazil for review and approval. No drainage approval will be granted until the erosion and sediment control plans have been approved by the Brazil City Council.

(e.) Failure to comply may also result in the non-issuance or withdrawal of building or occupancy permits for the parcels in non-compliance.

Sec. 1-26 Placement of Utilities.

No utility company may disturb existing storm drainage facilities without the consent of the **Brazil City Engineer**, whose decision may be appealed to the **Brazil City Council**. All existing drainage facilities shall have senior rights.

Sec. 1-27 Time Limits for Permits.

(a.) Before the commencement of construction of a new building or of a stormwater drainage facility or system for an existing building, the owner shall personally apply in writing to the **Brazil City Council** for a permit to construct a stormwater detention facility or system, which application shall set out the date of the intended construction, exact location, any plans, specifications and any other information deemed necessary by the **Brazil City Engineer**, and expressly state that the owner has complied, and will at all times comply with the standards set out in this Ordinance.

(b.) If the work described in a drainage permit has not commenced within 180 days from the date of permit issuance, the permit will expire and a written cancellation notice will be sent to the property owner/developer. If the work described in a drainage permit has not been substantially completed (90 percent completed) within one (1) year of the date of issuance thereof, said permit will expire and written notice will be sent to the property owner/developer. A written extension of up to 180 days may be granted by the **Brazil City Engineer** if the work in progress exceeds 50 percent completion. All other instances must reapply for a new permit.

(c.) Drainage permits granted prior to this Ordinance will be controlled as follows: Upon the adoption of this Ordinance, notice will be sent to all existing permit holders, thereby giving notice that they are now under a time limit as defined by this Ordinance and that their time begins at the date of the passage of this Ordinance.

Sec. 1-28 Change in Plans.

Any significant change or deviation in the detailed information after receipt of a Drainage Permit shall be filed with and approved in writing by the **Brazil City Engineer** prior to the land development involving the change. Significant shall mean any change which will result in greater than:

(a.) A 10% reduction in flow capacity of any conveyance systems; or

(b.) A 10% increase in required storage volume of any detention system; or

(c.) A 0.3 foot increase or decrease in 100-year elevation of a detention/retention facility.

Copies of the changes, if approved, shall be attached to the final plans and specifications submitted for the Drainage Permit.

Permits can be pulled and/or property transfers can be held if it is found that plans other than those approved by the **Brazil City Engineer** are being used for construction.

Sec. 1-29 Certifications Required for As-Built Condition.

After completion of the project and before the issuance of a certificate of occupancy, and acceptance of the completed construction project from approved plans, a professionally prepared and certified "Record Set" or "As-Built" set of plans shall be submitted to the **Brazil City Engineer** for review. These plans shall include all pertinent data relevant to the completed storm drainage system and shall include as a minimum:

(a.) Pipe size and pipe material.

(b.) Invert elevations.

(c.) Top rim elevations.

(d.) Lengths of all pipe structures.

(e.) Data and calculations showing constructed detention basin storage volume.

(f.) Certified statement on plans saying the completed storm drainage system substantially complies with the final plans as approved by the **Brazil City Engineer.**

Within ten (10) days after completion of a land alteration for which a drainage permit was required and relative to which a certified plan was required to be filed, a registered professional engineer, land surveyor, or architect, engaged in storm drainage design, shall execute and file with the **Brazil City Engineer** a Certificate of Completion and Compliance. Such certificate shall be in the format depicted in Figure 6.

Sec. 1-30 Subdivision Covenants.

The following statements shall become part of the Restrictive Covenants of ***every*** platted subdivision:

(a.) "It shall be the responsibility of the owner of any lot or parcel of land within the area of this plat to comply at all times with the provisions of the drainage plan as approved for this plat by the **Brazil City Council** through its agents, the **Brazil City Engineer**, and the requirements of all drainage permits for this plat by said **Brazil City Council".** Each lot owner shall be responsible for maintenance, including replacement or repair, or any drainage facility situated on such land owner's lot. The maintenance of any drainage facility located on a common area not owned by any one lot owner shall be the joint and several responsibility of all lot owners located within the subdivision.

(b.) "The property shall be graded pursuant to the final construction plan and may not thereafter be changed without written approval of the **Brazil City Engineer**, whose decision may be appealed to the **Brazil City Council**".

(c.) "No trees or shrubs shall be planted, nor any structure erected in any drainage easement, unless otherwise approved by the **Brazil City Engineer**".

(When requested in writing, the above covenant may be waived or modified by the **Brazil City Council** for good cause.)

(d.) "Drainage swales (ditches) along dedicated roadways and within the right-of-way, or on dedicated drainage easements, are not to be altered, dug out, filled in, tiled, or otherwise changed without the written permission of the **Brazil City Council**. Property owners must maintain these swales as sodded grassways, or other non-eroding surfaces. Water from roofs or parking areas must be contained on the property long enough so that said drainage swales or ditches will not be damaged by such water. Driveways may be constructed over these swales or ditches only when appropriate sized culverts are installed.

(e.) "Any property owner altering, changing, or damaging these swales or ditches will be held responsible for such action and will be given ten (10) days notice by registered mail to repair said damage, after which time, if no action is taken, the **Brazil City Council** retains the right to cause said repairs to be accomplished, and the bill for such repairs will be sent to the affected property owner for immediate payment".

Sec. 1-31 Inspections and Corrective Measures.

Nothing herein contained shall prevent the City of Brazil from taking such other lawful action as may be necessary to prevent or remedy any violation. All costs incurred by the City of Brazil in connection therewith shall accrue to the person or persons responsible, including reasonable attorney and engineering fees.

(a.) <u>Inspections</u>

All public and privately owned stormwater conveyance systems and detention storage facilities may be inspected by representatives of the City of Brazil bearing proper credentials and identification.

(b.) Corrective Measures

If deficiencies are found by the inspector, written notice of violation shall be sent to the owner by certified mail. A time limit of fifteen (15) days shall be given for the remedy of the violation. If the owner fails to correct the noted deficiencies, the City of Brazil may begin assessing a $500.00 per day fine until the violation is corrected. In addition, the City of Brazil reserves the right to undertake the work and collect the cost of maintenance or repair from the owner using lien rights if necessary.

(c.) Enforcement of the Ordinance by the City of Brazil shall be supplemental and in addition to the rights of individual landowners as provided by law, including private enforcement of restrictive covenants, or those rights under Indiana Code 36-9-27.4.

Sec. 1-32 Disclaimer of Liability.

The degree of protection required by this ordinance is considered reasonable for regulatory purposes and is based on historical records, engineering and scientific methods of study. Larger storms may occur or stormwater runoff depths may be increased by man-made or natural causes. This ordinance does not imply that land uses permitted will be free from stormwater damage. This ordinance shall not create liability on the part of the City of Brazil or any officer or employee thereof for any damage which may result from reliance on this ordinance or on any administrative decision lawfully made thereunder.

Sec. 1-33 When Effective.

This ordinance shall become effective after its final passage, approval and publication as required by law.

Sec. 1-34 Exempt Projects.

All residential, commercial or industrial subdivision (major or minor) or construction project thereon, which has had its drainage plan approved by the **City of Brazil** prior to the effective date of this ordinance shall be exempt from all of the requirements of this ordinance.

Sec. 1-35 Permit Fees.

The **Brazil City Council** requires that a $1,200.00 review fee be submitted with plans and drainage calculations. This $1,200.00 fee will be used to pay for the review of the submittal. If the review fee is less than $1,200.00, the balance will be returned to the owner. If the review fee exceeds $1,200.00, the owner will be responsible for making up the difference between the

$1,200.00 submitted and the actual review costs.

Sec. 1-36 Detailed Drawings of Design Standards.

Technical Standards and Drawings may be added as Appendices to this Article by either the **Brazil City Engineer** as deemed necessary. All additions will be approved by the **Brazil City Engineer**.

Sec. 1-37 Penalties.

The **City of Brazil** may bring suit to enjoin the violation of this Article. If deficiencies are found by the inspector, written notice of violation shall be sent to the owner by certified mail. A time limit of fifteen (15) days shall be given for the remedy of the violation. If the owner fails to correct the noted deficiencies, the City of Brazil may begin assessing a $500.00 per day fine until the violation is corrected. In addition, the City of Brazil reserves the right to undertake the work and collect the cost of maintenance or repair from the owner using lien rights if necessary. Said fifteen (15) days grace period may be shortened by the **City of Brazil** if deemed necessary due to emergency considerations.

Sec. 1-38 through 1-50 Reserved for future uses.

Ordinance ~~1997-3D~~ 01-2000 is adopted this 18TH day of July, 20 00.

Brazil City Council

Attest: Janet Wallace
Brazil Clerk-Treasurer

Kenneth L. Crabb
Kenneth L. Crabb, Mayor

James Sheese
Member

Ann Bradshaw
Member

Member

Jean Sneddon
Member

Patricia Heffner
Member

APPENDIX

AND

REFERENCES

FIGURE 1
Time of Concentration Worksheet

Project ______________________________ By ______ Date ________

Location ______________________________ Checked ______ Date ________

Circle one: Present Developed ______________________

Circle one: T_c T_t through subarea ______________________

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

Item	Unit	Segment ID		
1. Surface description (table 3-1)				
2. Manning's roughness coeff., n (table 3-1) ..				
3. Flow length, L (total L ≤ 300 ft)	ft			
4. Two-yr 24-hr rainfall, P_2	in			
5. Land slope, s	ft/ft			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	+		=

Shallow concentrated flow

Item	Unit	Segment ID		
7. Surface description (paved or unpaved)				
8. Flow length, L	ft			
9. Watercourse slope, s	ft/ft			
10. Average velocity, V (figure 3-1)	ft/s			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	+		=

Channel flow

Item	Unit	Segment ID		
12. Cross sectional flow area, a	ft^2			
13. Wetted perimeter, P_w	ft			
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r	ft			
15. Channel slope, s	ft/ft			
16. Manning's roughness coeff., n				
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s			
18. Flow length, L	ft			
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) .... hr ____

FIGURE 2
Detention Storage Calculations Worksheet

Project: ______________________________ Detention Facility Design Return Period __________ years
Designer ______________________________ Release Rate Return Period _________ years
Watershed Area ______________________ acres
Time of Concentration (undeveloped watershed) __________________________ minutes
Rainfall Intensity (i_u) ____ inches/hr
Undeveloped Runoff Coefficient (C_u) ____________________________________
Undeveloped Runoff Rate ($O=C_ui_uA_u$) _________________________________ cfs
Developed Runoff Coefficient (C_D) _______________________________________

Storm Duration t_d (hrs)	Rainfall Intensity i_d (in/hr)	Inflow Rate $I(t_d)$ $(C_di_dA_D)$ (cfs)	Outflow Rate O $(C_ui_uA_u)$ (cfs)	Storage Rate $I(t_d) - O$ (cfs)	Required Storage $[I(t_d) - Ot)]*(t_d/12)$ (acre-ft)

Source: HERPICC Stormwater Drainage Manual, July 1994, Figure 6.2.3

FIGURE 3
Street and Gutter Capacities

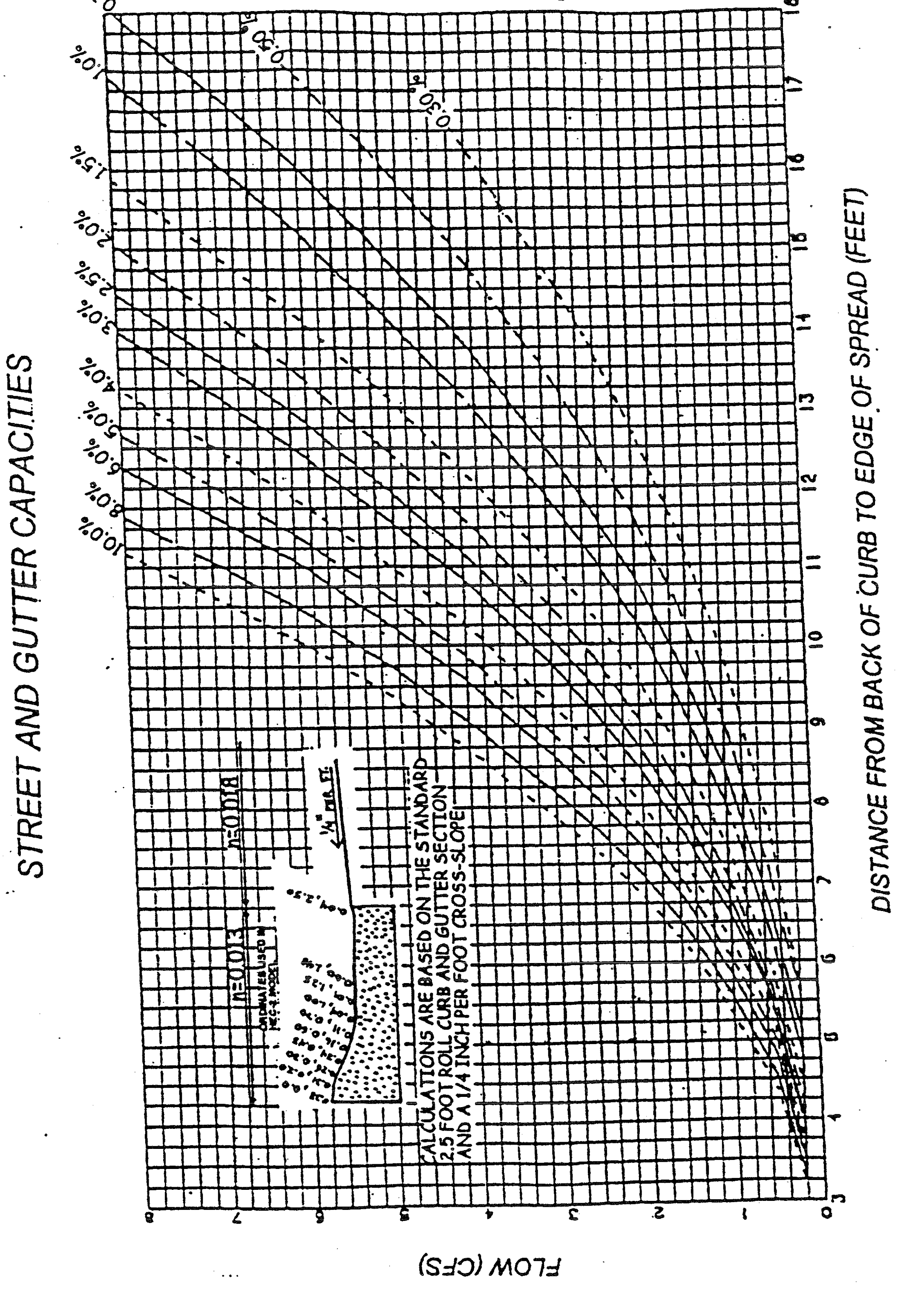

FIGURE 4
Wet-Bottom Detention Facility - Without Fence

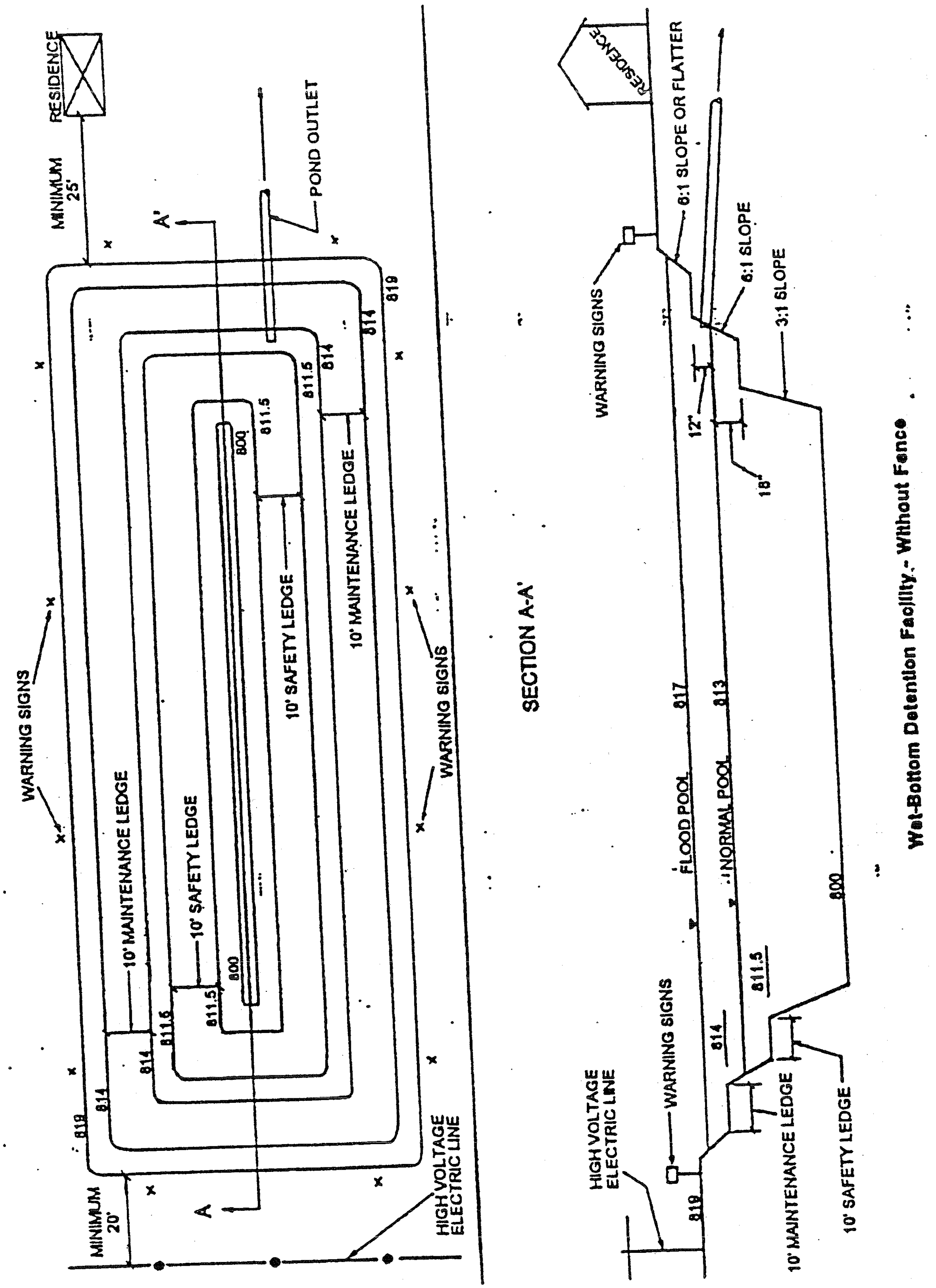

FIGURE 5
Wet-Bottom Detention Facility - With Fence

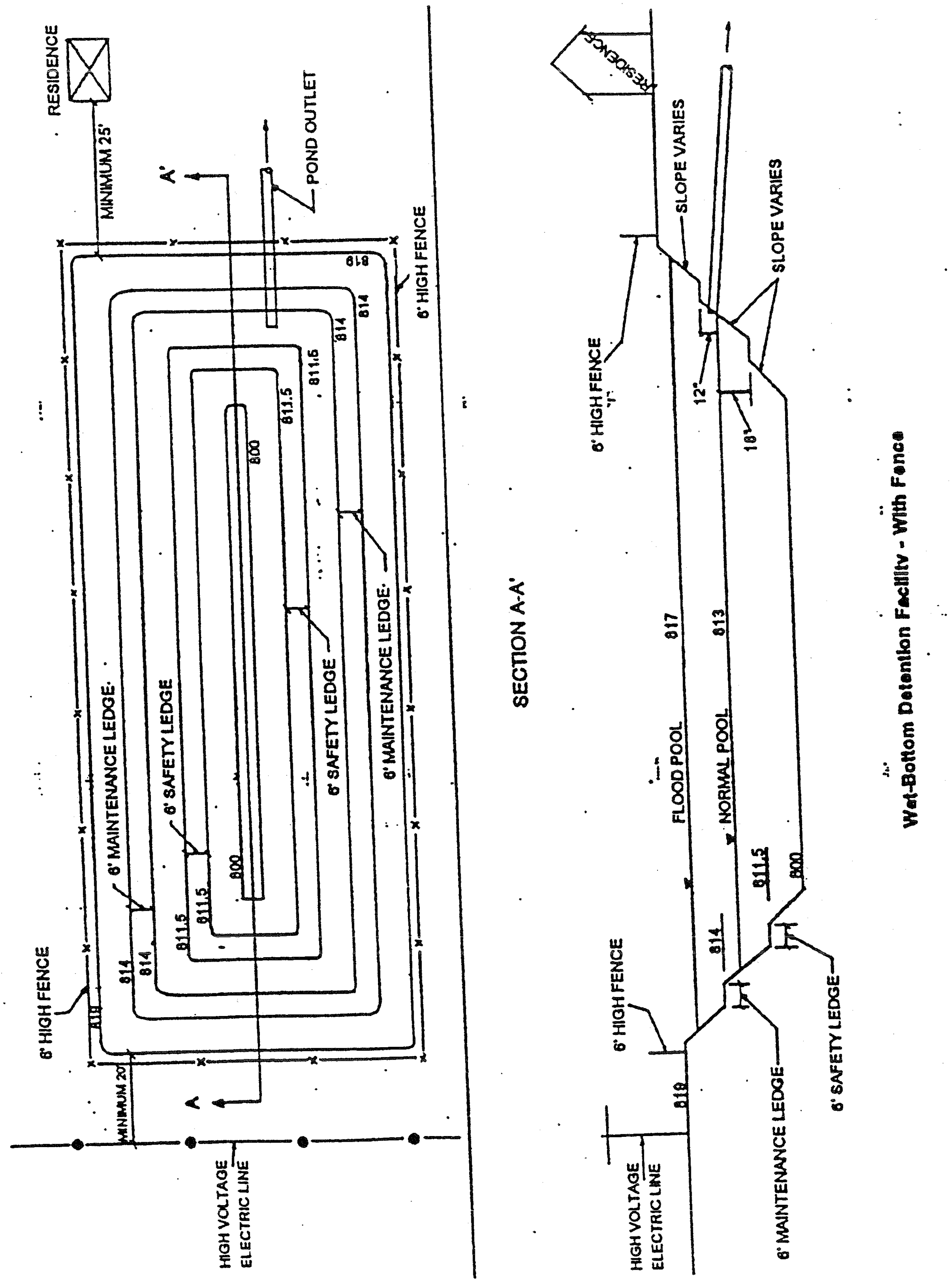

FIGURE 6.
CERTIFICATION OF COMPLETION AND COMPLIANCE

CERTIFICATE OF COMPLETION & COMPLIANCE

Address of premises on which land alteration was accomplished:______________________________
____
____

Inspection Date(s):________________________ Permit Number:________________

Relative to plans prepared by:____________________________ on __________________
(date)

I hereby certify that:

1. I am familiar with drainage requirements applicable to such land alteration; and

2. I have personally observed the land alteration accomplished pursuant to the above referenced drainage permit; and

3. To the best of my knowledge, information and belief such land alteration has been performed and completed in conformity with all such drainage requirements, except _____
____
____

Signature: ___________________________ Date: ____________________________

Typed or Printed Name: ____________________________ Phone: (___)________________

(SEAL)

Business Address: ____________________________
____
____
____

SURVEYOR ENGINEER ARCHITECT
(Circle One)

Indiana Registration No. ___________________________

TABLE 1
Urban Runoff Coefficients

Type of Surface	Runoff Coefficient "C"
Asphalt	0.90
Concrete	0.95
Roof	0.95
Water Impoundment	1.00
Lawns (minimum grass height 1½ inches)	
Flat (0-2% Slope)	0.20
Rolling (2-7% Slope)	0.25
Steep (Greater than 7%)	0.35

Source: Adapted from HERPICC Stormwater Drainage Manual, July 1994, Table 3.2.2

TABLE 2
Rural Runoff Coefficients

Type of Surface	Runoff Coefficient "C"
Woodland	
Flat (0-5% Slope)	0.40
Rolling (5-10% Slope)	0.50
Steep (Greater than 10% Slope)	0.60
Pasture	
Flat (0-5% Slope)	0.40
Rolling (5-10% Slope)	0.55
Steep (Greater than 10% Slope)	0.60
Cultivated	
Flat (0-5% Slope)	0.60
Rolling (5-10% Slope)	0.70
Steep (Greater than 10% Slope)	0.82

Source: Adapted from HERPICC Stormwater Drainage Manual, July 1994, Table 3.2.1

TABLE 3
Rainfall Intensities for Various Return Periods and Storm Durations
(Terre Haute, IN)

Intensity (Inches/Hour)						
Duration	Return Period (Years)					
	2	5	10	25	50	100
1 Hr.	1.43	1.83	2.16	2.50	2.91	3.16
2 Hrs.	0.89	1.16	1.28	1.46	1.65	2.00
3 Hrs.	0.65	0.85	1.02	1.16	1.25	1.47
6 Hrs.	0.39	0.50	0.60	0.69	0.75	0.85
12 Hrs.	0.22	0.29	0.33	0.40	0.43	0.49
24 Hrs.	0.13	0.17	0.19	0.22	0.25	0.27

Source: Purdue, A.M., et. al., “Statistical Characteristics of Short Time Incremental Rainfall”, August, 1992.

TABLE 4
Coefficients for the IDF Equation
(Indianapolis, Indiana)

Storm Duration (hrs) = t	c	a	d	B
0.083 < t ≤ 1 hour	2.1048	0.1733	0.47	1.1289
1 hour < t < 36 hours	1.5899	0.2271	0.725	0.8797

Source: Purdue, A.M., et.al., "Statistical Characteristics of Short Time Incremental Rainfall", August, 1992.

TABLE 5a
Runoff Curve Numbers for Urban Areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.
[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

TABLE 5b
Runoff Curve Numbers for Cultivated Agricultural Lands[1]

Cover description			Curve numbers for hydrologic soil group—			
Cover type	Treatment[2]	Hydrologic condition[3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T + CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T + CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and $I_a = 0.2S$.
[2] *Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.
[3] Hydrologic condition is based on combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.
Poor: Factors impair infiltration and tend to increase runoff.
Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

TABLE 5c
Runoff Curve Numbers for Other Agricultural Lands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	[4]30	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	[4]30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1]Average runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.

[3]*Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

TABLE 5d
Runoff Curve Numbers for Arid and Semiarid Rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

TABLE 6
Hydrologic Soil Groups for Soils in Clay County, Indiana

Soil Type		Hydrologic Soil Group
AnC	Alvin loamy fine sand	B
AvB2	Ava silt loam	C
Ay	Ayrshire fine sandy loam	C
BdF	Berks-Gilpin complex	C
BmD	Bloomfield loamy fine sand	A
Bo	Bonnie silt loam	C/D
Ca	Chagrin silt loam	B
Cb	Chagrin-Stonelick complex	B
CcC2	Cincinnati silt loam	C
CeC3	Cincinnati Variant silt loam	C
ChF	Chetwynd loam	B
CoA	Cory silt loam	C
Ev	Evansville silt loam	B/D
FcB	Fairpoint shaly silt loam	C
FcG	Fairpoint shaly silty clay loam	C
GmE	Gilpin-Wellston silt loams	C
HbA	Henshaw silt loam	C
HcB	Hickory silt loam	C
HcE/HcF	Hickory loam	C
Ho	Hoosierville silt loam	C
IvA	Iva silt loam	C
Lo	Lobdell silt loam	B

TABLE 6 Continued

Soil Type		Hydrologic Soil Group
Ly	Lyles fine sandy loam	B/D
Mt	Montgomery Variant silty clay loam	D
MuA/MuB2	Muren silt loam	B
Ne	Newark silt loam	C
No	Nolin silt loam	B
Nr	Nolin silty clay loam	B
PaD2	Parke silt loam	B
Pf	Peoga silt loam	C
Pg	Petrolia silty clay loam	B/D
PKA PkB2 PkC2	Pike silt loam	B
PnB PnC	Princeton fine sandy loam	A
Sh	Shoals silt loam	C
Sk	Steff silt loam	C
Sn	Stendal silt loam	C
VgA	Vigo silt loam	D
WeD2	Wellston silt loam	B
Wm	Wilbur silt loam	B
Zp	Zipp silty clay	D
Zs	Zipp silty clay loam	D

Source: HERPICC Stormwater Drainage Manual, July 1994, Table 3.2.2.

Notes:
- Soils having two classifications shall use their highest curve number for undeveloped lands.
- Post-developed lands, if drained, may use the lower curve number of their classifications.

TABLE 7
Rainfall Depths for Various Return Periods and Storm Durations
(Terre Haute, IN)

Depth (Inches)						
Duration	Return Period (Years)					
	2	5	10	25	50	100
1 Hr.	1.43	1.83	2.16	2.50	2.91	3.16
2 Hrs.	1.78	2.32	2.56	2.92	3.3	4.00
3 Hrs.	1.95	2.55	3.06	3.48	3.75	4.41
6 Hrs.	2.34	3.01	3.60	4.16	4.51	5.10
12 Hrs.	2.64	3.48	3.96	4.80	5.16	5.88
24 Hrs.	3.12	3.96	4.66	5.16	6.00	6.55

Source: Purdue, A.M., et. al., "Statistical Characteristics of Short Time Incremental Rainfall", August, 1992.

TABLE 8
Huff Third Quartile (50%) Rainfall Distribution

Cumulative percent of Storm Rainfall for Given Storm Type	
Cumulative Percent of Storm Time	Cumulative Percent of Rainfall Depth
5	3
10	6
15	9
20	12
25	15
30	19
35	23
40	27
45	32
50	38
55	45
60	57
65	70
70	79
75	85
80	89
85	92
90	95
95	97
100	100

Source: Purdue, A.M., et al, "Statistical Characteristics of Short Time Incremental Rainfall", August, 1992.

TABLE 9
Values of Manning's "n" and Maximum Allowable Velocities

Material	Manning's	Maximum
Closed Conduits		
Concrete	0.013	15 f.p.s.
Vitrified Clay	0.013	15 f.p.s.
Brick	0.017	15 f.p.s.
Cast Irom	0.013	15 f.p.s.
Circular Corrugated Metal Pipe		
Unpaved	0.024	7 f.p.s.
25% Paved	0.021	7 f.p.s.
50% Paved	0.018	7 f.p.s.
100% Paved	0.013	7 f.p.s.
Concrete Culverts	0.013	15 f.p.s.
High Density Polyethylene	0.01	10 f.p.s.
Interior Corrugated Polyethylene		
4"-15" diameter	0.018	10 f.p.s.
18"-36" diameter	0.02	10 f.p.s.
Open Channels (straight alignment)		
Concrete, Trowel Finish	0.013	15 f.p.s.
Concrete, Broom or Float Finish	0.015	15 f.p.s.
Gunite	0.018	15 f.p.s.
Riprap Placed	0.035	10 f.p.s.
Riprap Dumped	0.04	10 f.p.s.
Gabion	0.028	10 f.p.s.
New Earth (Uniform, Sodded)	0.025	3-5 f.p.s.
Existing Earth (Fairly Uniform)	0.03	3-5 f.p.s.
Dense Growth of Weeds	0.04	3-5 f.p.s.
Dense Weeds and Brush	0.04	3-5 f.p.s.
Swale With Grass	0.035	see Table 10

Source: Adapted from HERPICC Stormwater Drainage Manual, July 1994, Table 4.2.1.

TABLE 10
Maximum Permissible Velocities in Vegetated-Lined Channels [1]

Cover	Side Slope Range [3] (Percent)	Permissible Velocity [2]	
		Erosion Resistant Soils (ft. Per sec.) [4]	Easily Eroded Soils (ft. Per sec.) [4]
Bermuda Grass	0-5 5-10 Over 10	8 8 6	6 5 4
Bahia Buffalo Grass Kentucky Bluegrass Smooth Broome Blue Grama	0-5 5-10 Over 10	7 6 5	5 4 3
Grass Mixture Reed Canary Grass	[3]0-5 5-10	5 4	4 3
Lespedeza Sericea Weeping Lovegrass Yellow Bluestem Redtop Alfalfa Red Fescue	[4]0-5 5-10	3.4	2.5
Common Lespedeza[5] Sundangrass[5]	[6] 0-5	3.5	2.5

1/ From Soil Conservation Service, SCS -TP-61, "Handbook of Channel Design for Soil and Water Conservation".

2/ Use velocities exceeding 5 feet per second only where good channel ground covers and property maintenance can be obtained.

3/ Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

4/ Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

5/ Annuals - use on mild slopes or as temporary protection until permanent covers are established.

6/ Use on slopes steeper than 5 percent is not recommended.

Certificate of Sufficiency of Plan

Name of Project: ____

Location where land alteration is occurring: ______________________________

____

Plan Date(s): ________________________

I hereby certify that to the best of my knowledge and belief:

(1) The drainage plan for this project is in compliance iwth drainage requirements pertaining to this class work.

(2) The calculations, design, reproducible drawings, masters and original ideas reproduced in this drainage plan are under my domain and control and they were prepared by me and my employees.

Signature ___________________________________ Date _______________

Type or Print Name ____

(SEAL)

Surveyor ___________ Engineer ___________ Architect _________

Indiana Registration Number _______________

[If letterhead stationary is not used, include:]

Business address ____

Phone (______) ____________________

DRAINAGE PERMIT

Permit Number: ______________________________ Date: ____________________________

Name of Project: ____

Location of Project: ____

____

Drainage Plan Design Firm: ____

____

This drainage system is to be made a regulated drain. The necessary documents for the regulated drain are to be filed with the Brazil City Engineer prior to the recordation of the plat.

Drainage is hereby approved as submitted per plans, plan amendments and/or written clarifications and is released for construction to begin.

Notice for Inspections

The Owner or the Owner's agent must notify the Brazil City Engineering, 24 hours in advance of starting construction, for inspections to be made during construction.

____________________________________ Date ______________________________

Brazil City Engineer

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*Street and Gutter Capacities (Figure 3) taken from Tippecanoe County Drainage Ordinance, Adopted November 7, 1988.